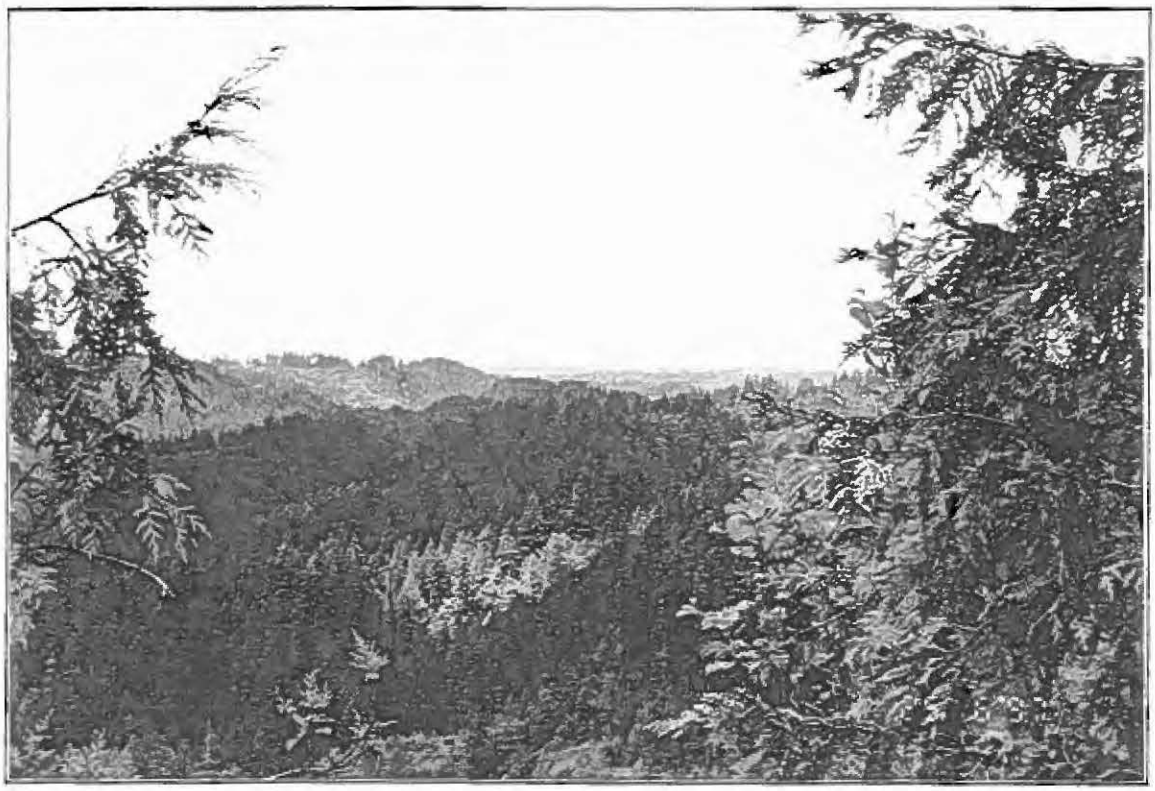
Lower Siuslaw Watershed Analysis



Prepared for

Siuslaw National Forest
Mapleton Ranger District

Prepared by

SRI/SHAPIRO/AGCO, Inc.

February 13, 1998

DRAFT

Lower Siuslaw Watershed Analysis

Prepared for

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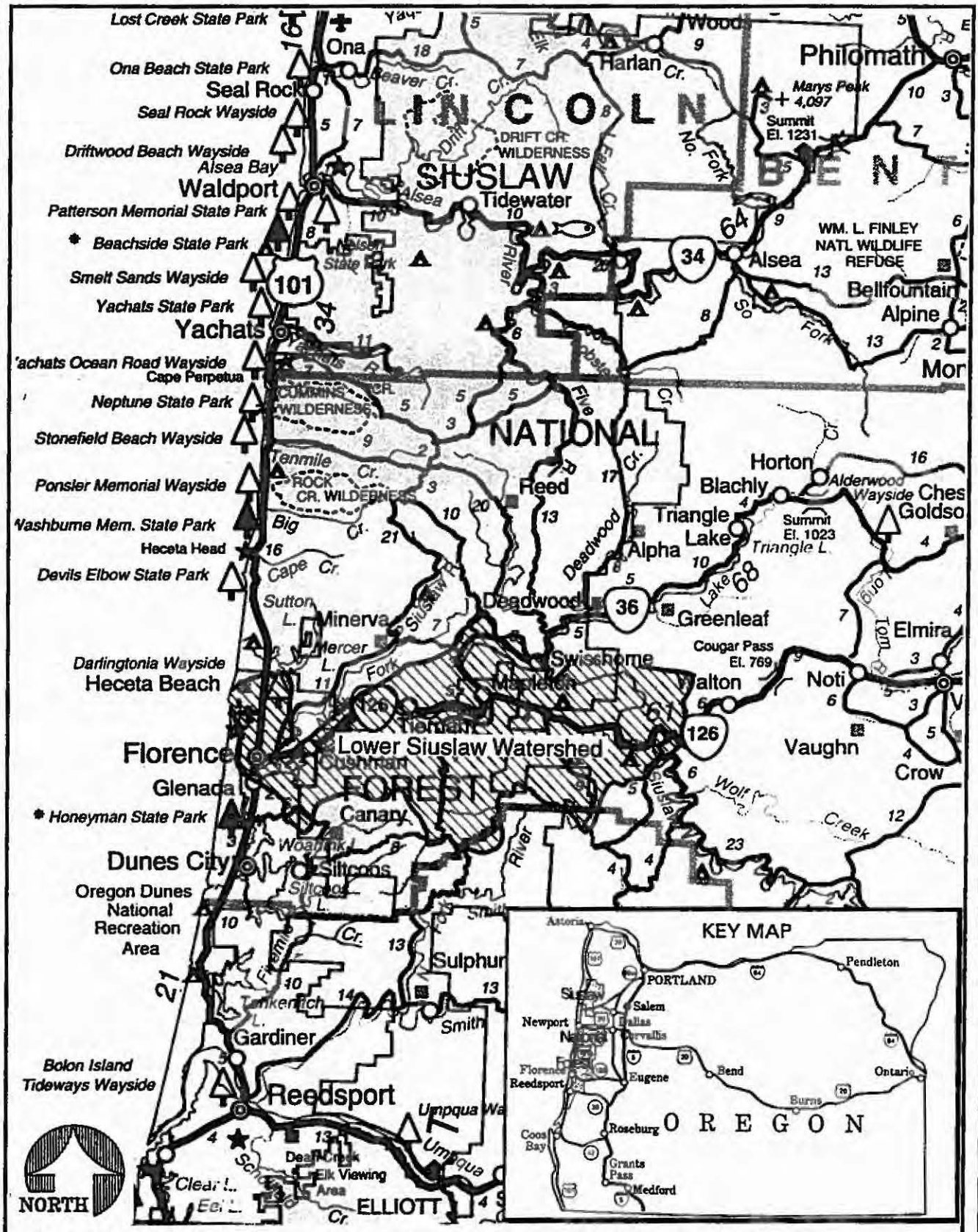
1.0 INTRODUCTION

The information and data contained here is ultimately provided and intended for use by federal land managers for making decisions pertaining to ecosystem management objectives specified in the "Record of Decision" (ROD) for Amendments to U.S. Forest Service (USFS) and Bureau of Land Management (BLM) Documents within the Range of the Northern Spotted Owl (USDA/USDI, 1994b).

This is the first iteration of the Lower Siuslaw watershed analysis. It was conducted as an initial step for implementing the Northwest Forest Plan (NWFP), as defined by the ROD, in the watershed. As with other watershed analyses within the region, this effort assesses current conditions and compares them with past conditions in an attempt to ascertain:

- A scientifically based understanding of the natural processes and human interactions occurring in the watershed;
- any conditions in the watershed that do not meet standards and guidelines as specified by the ROD; and
- opportunities and strategies that, if implemented, could help meet ROD objectives.

The six step process defined in, Ecosystem Analysis at the Watershed Scale-Federal Guide for Watershed Analysis, Version 2.2 (EPA, et al., 1995) was used to conduct this watershed analysis. The USFS provided a set of key issues and questions to expedite and narrow the focus of analysis.



Sources: ODOT 1992-1993 Official Highway Map of Oregon; Siuslaw National Forest Map, 1996

Lower Siuslaw Watershed Analysis
Location Map

Map 1

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2.0 CHARACTERIZATION

2.1 THE ANALYSIS AREA

2.1.1 Geographic

The Lower Siuslaw watershed is an 111,481-acre analysis area that lies in the southwestern portion of the Oregon Coast Range Physiographic Province (Map 1). It comprises about 23 percent of the entire Siuslaw River Basin.

- The watershed encompasses lands between the North Fork of the Siuslaw River to the north, and the Smith River to the south. It is bounded on the west by the Pacific Ocean and on the east by the mountains of the Coast Range. Florence and Mapleton are the primary towns in the watershed. The mouth of the watershed drains to the Pacific Ocean and occurs immediately west of Florence.

- There are a variety of landowners in the watershed (Table 1). Federal lands comprise about 43 percent (Map 2).

Table 1. Land Ownership in the Lower Siuslaw Watershed

Landowner	Acres	Percent of Watershed
USFS	42,990	39
BLM	4,563	4
Sate of Oregon	5,101	5
Private Industrial Forest Lands	34,783	31
Lane County	359	<1
Other Private Lands*	23,685	21

* Includes Florence, Mapleton, and Swisshome

2.1.2 Relief

The watershed ranges in elevation from sea level to about 2,160 feet near Walker Point, which is 25 miles inland.

- Approximately 8 percent of the watershed is a low relief coastal terrace adjacent to the coast. The remaining 92 percent is predominately steep, highly dissected mountainous terrain typical of the Coast Range.

2.1.3 Climate

- The climate of the area is best generalized as moderate, having a Mediterranean climate typified by wet winters and warm, dry summers (Oberlander and Muller, 1987). Mean annual temperatures are generally in the low 50's (degrees Fahrenheit), with mean annual summer temperatures in the low 60's, and mean annual winter

temperatures in the low 40's to high 30's. The range of average normal temperatures varies further inland from the coast; the highs increase slightly, while the lows decrease slightly (SCS, 1987).

- Most precipitation falls in the form of rain during the winter (November-February). Normal annual precipitation ranges from 60 to 80 inches on the coast, and from 80 to 100 inches in the Coast Range. Precipitation in a portion of upper Knowles Creek, along the south central ridge that defines the watershed divide, ranges from 100 to 150 inches annually (OSU, 1993).

- In winter, counterclockwise rotating low pressure centers that pass over the North Pacific dominate the weather pattern, bringing frontal, cyclonic storms with heavy rains and strong south to southwesterly winds. In summer, the pattern is dominated by fair weather and mild north-northwesterly winds with strong afternoon offshore breezes and coastal fog. Significant annual snow accumulations are rare, although light snow accumulations can occur at higher elevations during episodic cold fronts (Wiedemann, 1984).

2.2 LAND ALLOCATIONS, PLAN OBJECTIVES, AND REGULATORY CONSTRAINTS

- Siuslaw National Forest Land and Resource Management Plan (LRMP) March 7, 1990. The LRMP guides natural resource management activities. It establishes objectives and goals that, in part, enact a set of standards and guidelines that direct activities on the Siuslaw National Forest (SNF). A majority of the 1990 Forest Plan has been supplemented by the 1994 NWFP.

- Eugene District Proposed Resource Management Plan/Environmental Impact Statement (RMP) November 1994. The RMP, like the LRMP, guides natural resource management on BLM lands. It defines a resource management strategy for the proposed plan that was chosen from 5 different scenarios. Effects of implementing the chosen alternative are analyzed in detail in an environmental impact statement. Guidance within the document incorporates directives and policy set forth by the NWFP, and establishes a set of objectives for managing individual resources within BLM lands.

- Northwest Forest Plan (NWFP) April 13, 1994 (Map 2). The NWFP directs natural resource management activities by classifying Federal lands into allocations. Allocations have a set of specific objectives, standards, and guidelines for managing lands within them. Details of the land allocation standard and guidelines are listed in the ROD. Allocations designated by the NWFP are listed in Table 2.

Table 2. Land Allocations for Federal Land Within the Lower Siuslaw Watershed

Land Allocation	Acres		Percent of Watershed		Percent of Federal Land
	BLM	USFS	BLM	USFS	
Late Successional Reserve (LSR)	4,563	39,145	4	35	92
Riparian Reserves outside LSR*	0	1,484	0	1	3
Matrix Minus Riparian Reserves	0	2,361	0	3	5
Bald Eagle Management Areas	487	3,119	4	3	8

*Acres based on ROD default buffer widths for fish and non-fish bearing streams, not based on site potential tree height.

- There are two Late-Successional Reserve land allocations falling within the watershed (Map 3). The first, numbered R0268, comprises about 20 percent of the watershed, occurs almost entirely on Forest Service land, and lies primarily north of the Siuslaw River and Highway 126. Only about 5 percent of this LSR falls within the watershed. The second, numbered R0267, comprises about 35 percent of the watershed, occurs on Forest Service and BLM land, and lies primarily in the southern and eastern portions of the watershed. Approximately 25 percent of this LSR falls within the watershed.

- The Late-Successional Reserve (LSR) allocation on USFS lands has increased in acreage since the NWFP was enacted in 1994. This is due to an increase in marbled murrelet activity centers located since the inception of the plan (see Table 3). Suitable murrelet habitat within a half mile buffer circle around the activity centers requires protection mandated by standards in the N p+1XWFP. The acreage within those buffer circles is classified by the NWFP as LSR. Consequently, 547 acres of buffer circles, originally classified as Matrix in the initial NWFP land allocations, are considered LSR.

Table 3. Murrelet Buffers Added to LSR Since 1994

	Acres	Percent of Watershed
Murrelet Buffer (LSR) Located on Matrix Since 1994	4,410	4

2.3 HUMAN USES

2.3.1 Residents Within the Watershed Area

- The analysis area has a year-round population of around 12,000 residents. The Florence/Heceta Beach area has a population of about 10,000 people. There are another 2,000 people living in Mapleton, Swisshome, and on farms and small land holdings along the river or in side drainages.

- The Eugene/Springfield metropolitan area, population 225,000, is only 45 miles east of the center of the analysis area.

- The National Forest, BLM, State of Oregon, and Lane County lands, waters, dunes, and forests serve as an extended "backyard" for the local residents as well as the many recreationists that, during peak periods, can fill campgrounds, RV parks, vacation homes, and waterways.

2.3.2 Tribal and Cultural Resources

- There are no known treaty obligations related to the analysis area. Prior to settlement of the area by Euro/Americans, the area was home to Siuslaw Indians (Beckham, 1982).

- There are a number of cultural resource sites in the area. A determination of eligibility for the National Historic Register has not been completed for these sites (Steeves, 1997).

- Data from the 1990 census indicates that 240 individuals within the analysis area are American Indian, Eskimo, or Aleut.

2.3.3 Transportation Systems

- U.S. Highway 101 provides access across the western portion of the area. State Highways 126 and 36 follow the Siuslaw River and Knowles Creek routes. Access to and through the watershed is provided by a system of county, private residential, and forest development roads.

2.3.4 Land Ownership

- The Florence/Heceta Beach area is the most densely populated. Most homes and businesses are on relatively small lots.

- Small farms and rural residents form a corridor of private lands along State Highways 126 and 36 between Florence and Swisshome. Most of the National Forest lands are located in the uplands adjacent to the Siuslaw River. BLM, State of Oregon, and industrial forest lands are found in the eastern portions of the analysis area.

2.3.5 Public Access

- There is adequate access to most publicly owned land. There are a few isolated parcels of National Forest land that do not have open access from public roads. In May 1995, the public was involved in the revision of the Siuslaw National Forest Access and Travel Management Guide. This map and guide represents the road system needed to maintain adequate public access to and management of the national forest lands.

2.3.6 Recreation

- Recreation is a major activity along the Pacific Coast and inland dunes that form the western boundary of the watershed analysis area. The Florence/Heceta Beach area is heavily focused on tourist activities. There are numerous public facilities and accommodations in the area.

- The Siuslaw River is a major chinook salmon and steelhead fishing area. Within the area of tidal influence, most of the angling is done from boats. There are a number of marinas and boat launches along the river between Florence and Swisshome.

- Upland activities include hiking, gathering berries and mushrooms, as well as hunting for deer and elk. The USFS maintains four trail facilities in the Sweet Creek area and a nine-unit campground on Knowles Creek.

2.3.7 Landscape Aesthetics

- The landscape has changed through land clearing, agriculture, logging, dikes, and the development of businesses, homes, roads, and railroads. Once out of the heavily developed areas, the general surroundings are a pleasant mixture of coastline, dune, estuary, farm, pasture, river, and forest.

- Managed timber stands have quickly regenerated into a dense forest of young trees.

2.3.8 Commodity Production

Timber

- Prior to 1993, there was considerable focus on commodity production from National Forest, BLM, State of Oregon, and private industrial forest lands. Timber has been harvested at least once from 49 percent of the land in the watershed.

- The NWFP allocated most of the national forest and BLM lands within the analysis area to Late-Successional Reserves. As a result, the amount of National Forest and BLM timber programmed for harvest within the analysis area has been greatly reduced.

Special Forest Products

- The watershed is used to gather a number of small forest products. Firewood, boughs, mushrooms, ferns, moss and other natural materials are removed for personal and commercial uses.

Roads

- A road system totaling 558 miles has been developed within the area. Three highways, totaling 37.2 miles, are the primary arterial routes through the watershed. They are U.S. Highway. 101 (5.5 miles), State Route 36 (21.1 miles), and State Route 126 (10.6 miles). Most of the roads exist on privately owned and USFS lands (Table 4).

Table 4. Road Miles by Land Ownership (% of total)

Private	State	USFS	BLM
339 (61%)	11 (2%)	193 (35%)	11 (2%)

Mining

There are no known sources of locatable minerals in the analysis area. Several rock quarries provide rock for local and forest road development.

Commercial Fisheries

In the past, the streams in the watershed provided spawning and rearing habitat for large runs of salmon and steelhead.

2.4 GEOLOGY AND HILLSLOPE EROSION

- As with much of the southwestern coast range, including adjacent watersheds to the north, 85 percent of the Lower Siuslaw River watershed is underlain by layered, marine sedimentary rock formations that have been tilted generally north by tectonic uplift (USDA, 1997). Locally known as the Tyee Formation, this geologic unit has been widely researched. The steep slopes associated with the Tyee Formation are well known for exhibiting widespread unstable conditions prone to mass wasting.

- A small proportion of the watershed contains basalt intrusions (a type of igneous rock formation). They cap the prominent ridgelines of the northeastern and southern divides of the watershed, and comprise prominent mountain tops such as Mount Peter, Sunset Mountain, Goodwin Peak, and Walker Point. These formations are also known to exhibit unstable slope conditions.

- The western boundary of the watershed is bounded by the Pacific Ocean. Landforms adjacent to the coast are dominated by beach and dune landforms. Lands between the beach and the Coast Range mountains are comprised of gently rolling to flat lowlands underlain by marine sedimentary formations.

- Nine Land Type Associations (LTA) that partition areas of similar geomorphic, geologic, soil, and vegetative types across landscapes in the Coast Range are represented in the watershed. They consist chiefly of two recognized divisions called, the Alsea subsection and the Umpqua subsection (USDA, 1997).

- Descriptions of the individual LTA's in the watershed recognize debris slides and torrents as being the dominant hillslope erosion processes occurring in the watershed (USDA, 1997). Mass wasting and fluvial processes produce and transport sediments from the uplands to the lowlands. The highly dissected mountains of the watershed are shaped by these processes.

- Mass wasting or landslides in the Coast Range are often episodic events generally associated with high precipitation, wintertime storms. They can contribute large quantities of sediment to streams, and are considered to be a dominant process that historically introduced large woody debris into stream systems (Swanson, et al., 1982). Deep seated slumps and rotational mass movements occur less frequently. Landslides occur throughout the watershed except on the beach and coastal lowlands.

- Fluvial erosion, especially during flood events, also accounts for relatively large amounts of sediment to be transported downstream. Steep, incised drainageways are in part, shaped by fluvial erosion. The broad floodplain and tidal flats on the lower reaches of the mainstem river between Hoffman Creek and the town of Florence are shaped by the deposition of sediment transported by the river.

- Two other erosion processes in the watershed, though not widespread, are wind erosion and wave action that act upon the frontal coast landforms. The beach and sand dune landforms in the watershed are shaped by these processes.

- Total sediment production in the watershed is believed to have been increased to some degree between 1950 and 1980 due to a period of intense timber extraction activities that occurred in and along stream or valley bottoms. The difference between existing and pre-settlement sediment production is unknown. However, human induced accelerated erosion may be on the decline since, on the whole, timber harvest activities have decreased in the watershed over the last two decades, primarily on public lands.

2.5 HYDROLOGY

2.5.1 Subwatersheds and Streams

- The Lower Siuslaw watershed is approximately 174 square miles (111,481 acres) in size, and is divided into 23 subwatersheds. The Florence subwatershed represents the largest percentage and Cox Island the smallest percentage of the watershed (Table 5). The Lower Siuslaw watershed area comprises about 22 percentof the 775 square miles in the Siuslaw River Basin.

- The Lower Siuslaw watershed contains about 1,035 miles of perennial and intermittent streams. The mainstem Lower Siuslaw River, a seventh order river above Lake Creek and eighth below the creek, is a low gradient, moderately confined to unconfined channel. The Siuslaw River is tidally influenced up to river mile 27 at Cleveland Creek in the town of Tide.

- Table 5 displays miles of stream in gradient categories according to a classification scheme (Montgomery and Buffington, 1993). Gradient was determined using a digital elevation model (DEM) rather than querying Forest Service stream database records, since they were incomplete. Gradient records for many stream reaches on Forest Service land were lacking, and there were no records of stream gradient on private lands. Consequently, the DEM was used to approximate stream gradients. Data resulting from the method, and compiled here, indicate that approximately 53 percent of stream miles in the watershed have a gradient greater than 20 percent. In contrast, about 9 percent of the stream miles have gradients less than 4 percent. Tributaries of the Lower Siuslaw River, with the exception of Sweet and Knowles Creeks, are typically short, third and fourth order streams. Their lower reaches generally have lower gradients and unconfined channels (Rosgen C and E channels), while their upper reaches are steeper and more confined (mostly Rosgen A and some B channels; Rosgen, 1996).

Table 5. Acres and Stream Miles by Gradient for Subwatersheds in the Lower Siuslaw Watershed

Subwatershed	Acres (% of watershed)	STREAM GRADIENT (MI.)*		
		0-3%	3-20%	>20%
Barber	3,056 (3)	0.6	12.3	16.0
Berkshire	3,825 (3)	6.9	12.6	14.8
Cedar	4,572 (4)	0.9	22.4	32.9
Cox Island	1,649 (1)	7.0	4.4	3.1
Divide	8,738 (8)	14.0	32.6	37.8
Florence	11,439 (10)	24.6	7.8	0.3
Hadsall	5,457 (5)	1.5	24.7	33.1
Hand	7,668 (7)	4.2	37.6	48.1
Hoffman	2,715 (2)	0.5	12.5	28.0
Hood	2,203 (2)	0.7	7.7	8.0
Knowles	3,605 (3)	1.6	14.3	16.6
Lawson	3,956 (4)	3.5	17.7	30.5
Lower Sweet	3,710 (3)	3.8	16.8	26.8
Meadow	5,437 (5)	1.0	21.4	28.9
San Antone	3,483 (3)	0.3	13.2	14.1
Siboco	4,132 (4)	5.2	19.4	13.1
Thompson	7,543 (7)	3.0	32.3	39.8
Tilden	6,707 (6)	3.3	18.4	29.5
Turner	3,693 (3)	1.2	15.4	19.6
Upper Divide	2,615 (2)	0.5	13.2	13.9
Upper Knowles	6,621 (6)	1.1	22.7	39.6
Waite	3,872 (3)	1.6	12.3	16.4
Walker	4,785 (4)	3.7	14.7	26.9
Total	**111,481**	**90.7**	**406.4**	**538.0**

* Stream gradient ranges as defined by Montgomery and Buffington, 1993.

- Major tributaries in the watershed include the large, fifth order Sweet and Knowles Creeks and the smaller fifth order Lawson, Hoffman, Hadsall, and Turner Creeks. Medium-sized fourth order tributaries include Karnowsky, Divide, Walker, Thompson, Brush, Barker, San Antone, and Waite Creeks. The remaining named streams, (Siboco, South Inlet [Canary], Cedar, Elk Wallow, Fall, South Canyon, Hand, Gravel, South Fork Sweet, Sheep Ranch, Cabbage, Beaver, Deer, Jackson, Dinner, Hood, Sulphur, Old Man, Rack, Meadow, Smith, Rock, Beech, Pat, Tilden, Cleveland, Shoemaker, Berkshire, Hollenbeck, Saunders, Hansen, Schoolhouse, and Munsel Creeks), are small second, third, and fourth order streams flowing either directly into the Siuslaw River or are tributaries to Sweet or Knowles Creeks.

2.5.2 Discharge

- There is only one stream gage in the basin, a US Geological Survey (USGS) gage on the Siuslaw River, located in Mapleton (Lat.44(03'45", Long. 123(52'55", USGS gage #14307620). Data generated from this gage was used to estimate discharge quantities for the Lower Siuslaw watershed. The period of record for the Mapleton gage is 1967-1987.

- The estimated monthly average stream flow for the Lower Siuslaw is 637 cubic feet per second (cfs). Extrapolated maximum and minimum monthly stream flows are 1,330 cfs and 120 cfs, respectively. The extrapolated average annual base flow for the Lower Siuslaw is 25 cfs.

- The total average annual yield for the Lower Siuslaw watershed, using extrapolated data, is 458,969 acre-feet per year (ac-ft/yr) (Table 6).

Table 6. Estimated Water Yields from the Lower Siuslaw Watershed

	Lower Siuslaw*	Siuslaw Basin
Avg. Annual Total Yield (ac-ft/yr)	458,969.	1,551,000
Maximum Recorded Flow(cfs)	14,618	49,400
Minimum Recorded Flow (cfs)	13	45
Average Recorded Flow(cfs)	634	2,141

*Extrapolated from total basin data

cfs=cubic feet per second
ac-ft/yr=acre feet per year

- A recurrence interval is the probability that a certain magnitude of flood event will occur over a given time period. The USGS has estimated statistical measurements of the 1.25, 2, 5, 10, 25, and 50-year events for the watershed. The 100-year event was not included in the tabular USGS data because of an inadequate period of record. However, the 100-year event was computed by the USGS based on stage discharge relationship for the available years of data (Hubbard, pers. comm., 1998). Data provided by the USGS also were extrapolated from the representative watershed and are presented in Table 7 (for methodology, see Appendix A). Since the gauging station for the representative watershed was discontinued in 1987, data from the 1996 flood were not evaluated and reported. However, based on a mud line created in the dismantled gauging station at Mapleton, Oregon, by the 1996 flooding, it was estimated that the 1996 flood event was just under a 50-year event and produced an extrapolated discharge of 17,205 cfs.

Table 7. Discharge Frequencies for the Siuslaw River (Hubbard, pers. comm.)

Recurrence Interval (years)	Exceedance Probability (%)	Discharge (cfs)
1.25	80	5,593
2	50	7,990
5	20	11,304
10	10	13,464
25	4	16,187
50	2	18,199
100	1	20,321

2.5.3 Lakes

Munsel, Ackerley, Clear, and Collard Lakes, in the Florence subwatershed total approximately 20 acres, and are the only lakes in the Lower Siuslaw watershed area.

2.5.4 Estuary/Wetlands

- The Siuslaw River estuary is about 3,067 acres in size and is dominated by sand bottom in the subtidal zone and high salt marsh in the intertidal zone (Table 8). Most of the estuary has been designated as rural, with exclusive farm use (1,304 acres), impacted forest lands (645 acres), and natural resources (573 acres) as the dominate shoreland zones (Cortright, et al., 1987). Twenty dredged material disposal sites, totaling 143 acres, have been designated in the estuary (Cortright, et al., 1987). Only 58 acres have been identified for mitigation and/or restoration of subtidal/intertidal habitat.

- Wetlands within the Lower Siuslaw watershed are generally confined to riverine systems at the lower elevations. Using the National Wetland Inventory (NWI) maps and the Cowardin classification (Cowardin, et al., 1979), most wetlands are palustrine emergent systems (PEM) except for the estuary. Palustrine emergent systems are typified by nontidal wetlands dominated by persistent emergent vegetation with the following general characteristics: (1) less than 20 acres in size; (2) active wave-formed or bedrock shoreline features are lacking; (3) water depth in the deepest part of the basin is less than 2 meters (6 feet) at low water; and (4) salinity due to ocean-derived salts is less than 0.5 parts per thousand (Cowardin, et al., 1979).

Table 8. Habitat Summary of the Siuslaw River Estuary

Zone	Habitat Class	Habitat Subclass	Area (Acres)	% Of Estuary
Subtidal	Unconsolidated bottom	Unspecified type	347	11.3
		Sand	682	22.3
		Sand/mud	396	12.8
		Cobble/gravel	5	0.3
	Rock bottom	Bedrock	9	0.3
	Aquatic bed	Seagrass	6	0.2
Intertidal	Shore	Unspecified type	19	0.6
		Sand	51	1.7
		Sand/mud	23	0.7
		Mud	5	0.2
		Cobble/gravel	1	0.0
		Boulder	22	0.7
		Bedrock	14	0.5
	Flat	Unspecified type	22	0.7
		Sand	140	4.6
		Sand/mud	80	2.6
		Mud	134	4.4
	Aquatic bed	Unspecified type	2	0.0
		Seagrass	243	7.9
		Seagrass/algea	68	2.2
		Algea	16	0.5
		On sand	4	0.1
	Beach/bar	Sand	31	1.0
	Tidal marsh	Unspecified type	5	0.2
		Low salt marsh	58	1.9
		High salt marsh	684	22.3
Totals			**3,067**	**100**

Source: Cortright, et al., 1987

- The estuary is classified as estuarine subtidal and intertidal systems (E1 and E2, respectively) with areas of exposed surfaces and some areas of emergent irregularly exposed systems. The estuarine system has been highly influenced by diking and levee construction.

- The Lane County Soil Survey (USDA, 1987) displays approximately 6.5 miles of levees occurring along portions of Duncan Inlet, South Slough, the mainstem river, and Lawson Creek. About 4.1 miles occur around Duncan Inlet and, according to aerial photo interpretation, were constructed sometime after 1945. Levees constructed in the South Slough area and along the mainstem river reaches (approximately 1.7 miles) appear to have been constructed at several different times, some before 1945, other portions after 1963. The levees (0.7 mile) occurring along

the lower reaches of Lawson Creek appear to have been constructed between 1945 and 1963. The specific intention of these levees was not determined. They likely have altered the extent and function of the estuary to some degree.

2.6 AQUATIC SPECIES AND HABITAT

2.6.1 Species

- Five anadromous salmonid fish species occur in the mainstem Siuslaw River and most of the larger tributaries of the watershed. They are spring and fall chinook *salmon (Oncorhynchus tshawytscha)*, coho salmon (*O. kisutch*), chum salmon (*O. keta*), winter and summer steelhead (*O. mykiss*), and sea-run coastal cutthroat trout (*O. clarki*). Coho salmon were historically the most numerous salmonid in the watershed, followed by cutthroat trout and steelhead (Dewberry, 1995).

- The anadromous Pacific Lamprey (*Lampetra tridentata*) also occurs in the same streams as anadromous salmonids. Also, American shad (*Alosa sapidissima*), white sturgeon (*Acipenser transmontanus*) and green sturgeon (*Acipenser medirostris*) are found in the lower reaches and estuary of the Siuslaw River.

- Resident fish species inhabiting the watershed include coastal cutthroat trout, western brook lamprey (*Lampetra richardsoni*), riffle sculpin (*Cottus gulosus*), reticulate sculpin (*C. perplexus*), coast range sculpin (*C. aleuticus*), prickly sculpin (*C. asper*), dace (*Rhinichthys spp*), northern squawfish (*Ptychecheilus oregenensis*), shiners (*Richardsonius spp.*), suckers (*Catostomus spp.*), and marine and freshwater threespine stickleback (*Gasterosteus aculeatus*).

- Resident cutthroat trout and sculpin are widely distributed throughout the watershed and are probably found in most, if not all, third order and larger perennial streams.

- Spring and fall chinook salmon runs are found in the 46.6 miles of mainstem Siuslaw River and three miles of Duncan Inlet. Fall chinook salmon spawn in about 1.5 miles of Barber Creek, one-tenth mile of Brush Creek, 3.7 miles of South Inlet Creek, 9 miles of Sweet Creek, 1.3 miles of Turner Creek, 0.7 miles of Waite Creek, and about 10 miles of mainstem Knowles Creek.

- Chum salmon are found 16 miles upstream on mainstem Siuslaw River, upstream about 1.5 miles in Sweet Creek, and one mile in Divide Creek.

- Coho salmon, steelhead, sea-run cutthroat trout, and Pacific lamprey are found, in combination, in all accessible fourth order and larger low gradient (<3 percent), depositional channel reaches and some of their smaller, higher gradient (3-20 percent) channel reaches, totaling about 63 miles of stream. Streams identified as supporting only coho salmon, steelhead, and sea-run cutthroat trout are; Demming, Hoffman, Karnowsky, Lawson, Hanson, upper Divide, Walker, Thompson, Cleveland,

Shoemaker, Hollenbeck, Berkshire, Tilden, Pat, Beech, San Antone, Smith, Meadow, Rock, and Hadsall creeks. Munsel Creek probably contains only coho salmon and possibly sea-run cutthroat trout.

- The Ecological Significant Unit (ESU) for Oregon Coastal coho salmon has been designated as a Candidate Species for listing by the National Marine Fisheries Service (NMFS) and will be reevaluated in 2000. The NMFS postponed their decision on this ESU based on the strength of the Governor's Memorandum of Understanding on May 1997 and Oregon's Coastal Salmon Restoration Initiative Conservation Plan (March, 1997). The decision for Oregon coastal steelhead ESU has been extended for six months to review disagreements in the science that originally designated this ESU as threatened under the Endangered Species Act (ESA) of 1973. A decision regarding the listing of Oregon coastal steelhead is expected by February 9, 1998.

- The Oregon Rivers Information System (ORIS), developed by ODFW and the Bonneville Power Administration was also queried to provide additional information of potential fish distributions in the watershed (Forsberg, 1994). ORIS fish population information was available for most named tributaries in the Lower Siuslaw River watershed.

2.6.2 Habitat

- Stream reaches are stratified into source (>20 percent gradient), transport (3 to 20 percent gradient), and deposition (response) (<3 percent gradient) channels (Montgomery and Buffington, 1993). Based on Montgomery and Buffington stratifications, there are about 538 miles of source, 406 miles of transport, and 91 miles of response (depositional) stream channels in the Lower Siuslaw watershed.

- Depositional reaches, also referred to as "flats," "hotspots," or depositional areas, are treated with special concern, since they are most susceptible to change in channel morphology and habitat conditions and are usually the most productive stream reaches occupied by anadromous fish.

- Historically with the absence of agricultural development and logging in the watershed, tributary stream channels were generally in good to excellent condition and functioning properly, with habitat units within the bounds of natural distributions for habitat variables. However, natural epizotic events (pre-European settlement) in individual subwatersheds or tributaries that varied in intensity, time, and space, dictated the historic conditions of streams.

- Most, if not all, tributary streams occupied by anadromous salmonids probably contained high quality fish habitat most of the time. Although the quality and quantity of habitat varied over time, streams generally contained large amounts of scattered and clumped large woody debris (LWD pieces greater than 24 inches in diameter and 50 feet in length), good numbers of large, deep, complex pools, and sufficient amounts of high quality spawning gravel.

- Streams were bordered by riparian areas composed of late seral stage coniferous and deciduous forest. Beaver also played an important role in maintaining productive habitat conditions for resident and anadromous fish. Also, streams used by anadromous fish (especially coho and chinook salmon) were probably higher in nutrients due to high numbers of decaying, spawned-out carcasses.

- Currently, wild runs of anadromous salmonids (except fall chinook salmon) along the Oregon coast, including the Siuslaw River basin, have declined precipitously (ODFW, 1992). The spring chinook salmon run is listed as present in the Siuslaw River Basin, but in an unknown status (ODFW, 1992). Much of this decline can be attributed to degradation of fish habitat. Streams used by anadromous salmonids in the Lower Siuslaw watershed currently lack LWD, large quality pools, and mature trees in riparian areas.

2.7 VEGETATION PATTERNS

- The overall vegetation pattern of the watershed is highly fragmented, especially south of the Siuslaw River and on private forest land.

- The historic vegetation pattern in the watershed was formed by wildfires that burned across large areas of the landscape (Maps 4-7).

- Natural disturbances in the watershed were common in the past. Logging activities have now formed the present vegetative landscape.

- Virtually all of the present-day forest stands in the watershed are even-aged, with a single canopy and a simple structure.

- Conifers dominate species composition.

- Young conifer plantations occupy 25 percent of the watershed. These areas range from early seral conditions resulting from clearcutting to pole-sized stands established by reforestation planting.

- Industrial forestry companies own almost half of the young stands (47 percent).

- Many stands are commercial size. Over half of these stands are in the national forest.

- A few stands have been commercially thinned on federal lands (about 2,000 acres).

- Hardwoods and mixed hardwood/conifer stands occupy about one fourth of the watershed. Many of these stands are found in riparian zones.

- There are no significant areas in the watershed that currently meet the scientific definition of "old growth."

2.8 TERRESTRIAL WILDLIFE AND HABITAT

- Late-Successional Reserves (LSR R0267 and LSR R0268) comprise 92 percent of the federal land in the watershed; however, only 48 percent of the designated LSR has late-successional characteristics. The average stand age on federal lands is not known because stand birth date for all stands in the watershed is not complete.

- Large scale, stand replacement fires occurred in the western portion of watershed in the mid-1800s and in the northeastern corner prior to the 1920s. The influence of fires on habitat characteristics within the watershed has largely been eliminated by more recent land management activities.

- The majority (68 percent) of late successional forest within the watershed occurs on federal lands.

- Portions (6 percent) of the watershed currently contain forest stands that are unsuitable for mature and late successional forest dependent species. Many of these stands are young, dense stands with closed canopies which do not exhibit late successional characteristics.

- Private industrial forest lands may provide some foraging habitat for some late-successional forest dependent species. They also provide habitat for early- and mid-successional associated species.

- There are 20 spotted owl activity centers including three known nest sites and one territorial single (18 owl activity centers and all of the nest sites are on federal land).

- There are 36 occupied marbled murrelet sites documented in the watershed, 22 of which are centered on federal land.

- All the federal land within the LSR is designated as Critical Habitat for the marbled murrelet (USDI, 1996).

- The majority of federal land in the watershed south of the Siuslaw River is designated Critical Habitat for the spotted owl (USDI, 1992).

- There are three bald eagle management areas within the watershed (two on SNF lands, one on BLM lands).

- A variable width band of private lands bisects the watershed from east to west. The majority of private lands are located in the southeast portion of the watershed. These private lands are dominantly industrial forest lands. Private industrial forests generally provide limited or no habitat for most late successional forest dependent species and are not expected to provide this habitat in the future.

- The City of Florence is located in the far western portion of the watershed. The town of Mapleton and the communities of Siuslaw and Swisshome are located along the Siuslaw River. Generally, these areas do not provide habitat for any forest dependent species.

- Recreationally important species, such as Roosevelt elk, cougar, and black bear occur within the watershed. Habitat for these species is well distributed throughout the watershed on both private and federal lands.

3.0 ISSUES AND KEY QUESTIONS

3.1 INTRODUCTION

This step identifies the issues and key questions that will be addressed in this analysis. For this analysis, the Siuslaw National Forest and Mapleton Ranger District developed and identified the issues and key questions. The NWFP (USDA, 1994) provides management direction for federal land in the Lower Siuslaw watershed. Issues identified for this watershed analysis focus on the immediate concerns of implementing the NWFP. SHAPIRO was asked to identify issues not addressed in this iteration and data gaps.

3.2 ISSUE 1: WHAT OPPORTUNITIES EXIST FOR PROTECTING, MAINTAINING AND RESTORING THE AQUATIC HABITAT IN THE WATERSHED?

3.2.1 Key Questions

Aquatic Habitat

1. What is the existing condition of instream fish habitat and is there adequate habitat for sustaining viable fish populations?

2. Are there any known historic good to excellent anadromous fish production areas hotspots remaining in the watershed? If so, where are they, what is their present condition, and what makes them high quality?

3. What natural and/or human activities affect instream habitat?

4. What stream channels are stable and/or in an upward trend?

Anadromous Fish

1. What are the spatial and temporal anadromous fish populations and distributions (historic and current) in the watershed?

2. Where are the current unnatural fish passage barriers?

3. What natural and/or human activities affect fish populations and distributions in the watershed?

4. What fish species are considered priority species under federal, state or other criteria and what is their current status?

5. What management options are available to protect, maintain and restore Lower Siuslaw fish populations?

Hydrology

1. What is the current water temperature?

2. How does water temperature in the watershed compare to state water quality standards?

3. How susceptible is this area to landslides?

4. Where are the highest landslide potentials.

Riparian Areas

1. What are the major natural disturbances to riparian areas?

2. Are there vegetative or physical features in the riparian areas that will limit certain aspects of restoration?

3. What role is current riparian vegetation playing in stream shade potential?

Upland Forest Vegetation

1. What are the current seral conditions of vegetation?

2. What disturbances led to those conditions?

3. How can plantations be managed to obtain aquatic objectives of NWFP?

3.3 ISSUE 2: WHAT CONDITION IS THE ROAD SYSTEM IN AND WHAT LEVEL OF ACCESS IS NEEDED IN THIS WATERSHED?

3.3.1 Key Questions

1. When were roads constructed in this watershed?

2. Are there roads or sections of roads that are particularly vulnerable to erosion?

3. How do they relate to landslide potential?

4. How do they relate to construction techniques?

5. Are any culverts blocking fish passage?

6. What restoration is necessary?

7. Which roads are desired from a user perspective?

8. Which roads are desired from a management perspective?

9. Are there existing road use agreements that must be maintained?

10. Identify critical maintenance needs required to maintain stability of the required road system.

11. Where are the current LWD source areas?

12. Are sections of road impairing delivery of these source areas to the stream channel system?

3.4 ISSUE 3: WHAT IS THE CONDITION OF THE LATE-SUCCESSIONAL RESERVE LANDS AND HOW CAN THEY BE MANAGED TO FUNCTION AS A LATE-SUCCESSIONAL ECOSYSTEM?

3.4.1 Key Questions

Forest Vegetation

1. What were the general historic seral conditions (vegetation stages) in the watershed?

2. What were the natural disturbances that led to those conditions?

3. What are the differences in landscape structural features, i.e. patch sizes, fragmentation, etc., between current and natural (pre-management) conditions?

4. Is the current condition within the range of natural variability?

5. How can plantations be managed to obtain late-successional and matrix objectives of NWFP?

Late-Successional Habitat

1. How much of the current forest is considered to be mature conifer?

2. What is the spatial distribution of the mature conifer?

3. How could the current condition be improved to meet needs of late-successional forest species guilds (i.e. specify key connectivity corridors)?

4. How much of the current mature conifer is considered "interior mature habitat" (varied distances depending on the type of adjacent vegetation)?

5. What is the spatial distribution of the interior habitat?

6. Where are the "biological hot-spots" i.e. oldest, most structurally diverse areas?

7. How much suitable habitat is available for spotted owls and marbled murrelets in their provincial home range, and what is their distribution?

8. Are there specific areas outside federal lands in the watershed which serve an important function for connectivity?

9. Where are the key areas to target for land exchange potential?

10. What types of activities are critical to attainment of late-successional habitat give the existing conditions?

11. What is a feasible schedule for implementation of those activities?

12. Concerning riparian areas as habitat for terrestrial species, how fragmented or continuous is the vegetation along the stream courses and between upslope and riparian areas?

13. What other (threatened and endangered, and big game) species or habitats exist in the watershed?

14. What conditions are they in?

15. What unique habitats occur in the watershed?

16. Are there any known sensitive plant species in the watershed?

17. Any known survey and manage species?

18. Where is the quality Bald Eagle habitat?

19. What is the condition of habitat currently in use?

20. Select the best habitat for mapped areas.

21. How do current and proposed land uses (recreation areas, recreation routes, matrix land allocations) affect the function of the LSR i.e. does it fragment, lead to harassment of late-successional species, provide diversity?

22. What is the current road density?

23. How does this density affect late-successional forest and big game objectives?

3.5 ISSUES OR INFORMATION NOT ANALYZED IN THIS ITERATION

- historic blowdown occurrence
- complete listing of current road closure areas
- the role of the estuary in the watershed
- the effects of dikes and levees on aquatic habitat and anadromous fish species
- historic landslide inventory
- the effects of human disturbances, such as the road infrastructure, on the magnitude, timing, and duration of peak flows
- mollusks and macroinvertebrates
- fungi and macrophytes
- noxious weed effects

3.6 DATA GAPS

- condition and operation of existing tidegates and their effect on fish passage
- quantitative background sediment regime
- road conditions on portions of private industrial timberlands that were inaccessible during the roads condition assessment
- reference water temperature regime (pre-settlement time frame)
- Knowles Creek fish habitat data
- reference aquatic habitat conditions

4.0 CURRENT AND REFERENCE CONDITIONS

The purpose of this step is to develop detailed information on current and reference conditions that are relevant to the issues and key questions identified in Step 2, and to document the current range, distribution, and condition of core topics and other relevant ecosystem elements.

4.1 HUMAN USES

4.1.1 Cultural Resources and Area History

The Siuslaw Indians

- Prior to the immigration of Euro-American settlers, the Lower Siuslaw analysis area was home to the Siuslaw Indians. Their territory extended from Heceta Head on the north to Siltcoos Lake on the south and eastward up the Siuslaw River watershed to the Coast Range crest (Beckham, 1982).

- The Siuslaw people relied upon the salmon, shellfish, and plant life found in the estuaries and fresh water sources. Historic contact with the native people was made at the mouth of the Siuslaw River in 1826 by McLeod and others (Beckham, 1982). Several cultural resource areas, primarily camp sites, have been investigated. These sites are eligible for inclusion in the National Register of Historic Places (Steeves, 1997).

- The Siuslaw people appear to have used low-intensity fires to clear areas around villages and ridges to permit easy travel, and attract game. In 1835 and 1868, Indians reported large fires that "turned the sky black for two weeks" near the mouth of the Siuslaw (Lane County Historian, 1971). Historic photographs taken prior to 1889 clearly show that the area around Slide Gulch had been burned to the ridge top (Ward, 1982). The source of the fires is unknown but their existence is confirmed by historic vegetation map (Maps 4 to 7).

- The size of the Siuslaw Indian population in the early days is uncertain. Lewis and Clark were told by Natives in 1806 that there were 900 Siuslaws (Zenk, 1990). In 1876, fifty Indian villages were reported on the main stem and North Fork of the Siuslaw River (Lane Co. Historian, 1971). However, in 1880 the census recorded only 68 Siuslaw Indians living in the village on the river (U.S. Federal Census, Lane Co. 1880).

- In 1855, the Siuslaw River area was included in the Coast (later Siletz) Reservation. Starting in 1865, a series of events followed that diminished the size of the reservation. These actions continued until August 13, 1954, when government-to-government relations with the Indians ceased. In October of 1984, Public Law 98-481 restored Federal recognition to the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians. Members thus became eligible for all Federal services

and benefits furnished to recognized tribes lost under the Act of August 13, 1954. No treaty rights relate to the analysis area. However, the Siuslaw National Forest consults with local tribal leadership and staff regarding heritage and natural resource issues.

- In 1996, a Memorandum of Understanding between the Confederated Tribes of Siletz Indians of Oregon and the Siuslaw National Forest was developed for the coordination of natural and heritage resource management issues. No treaty obligations relate to the analysis area.

Euro-American Settlement of the Area

- The early settlement and later social/industrial development of the analysis area has provided a number of historical resources. Over forty historical sites have been documented (Map 8). They include schools, homesteads, ranger stations, cemeteries, Civilian Conservation Corps camps, roads, trails, bridges, and more. Each site provides a unique look at the past. Most are located along transportation routes and many are on privately owned land (Historic Site Data, undated). A determination of eligibility of these sites for possible inclusion in the National Register has not been completed for all sites (Steeves, 1997).

- The following are some events that shaped the area.

  1875 - Because of the Siletz Reservation, entry by settlers into the analysis area was prohibited until 1875. At that time the reservation was, once again, reduced in size to allow settlers to claim the lands (Beckham et. al., 1982). Despite these problems, the Siuslaws were never belligerent toward the settlers and did not take part in the hostilities of the 1850s in Southern Oregon (untitled report, "Lower Lake Creek Before Settlement," undated).

  1877 - A salmon cannery was established at Florence. The upstream navigability of the Siuslaw River, and its large tracts of bottom lands, contributed to rapid settlement along the lower river.

  1879 - The post office was established in Florence (Beckham et.al., 1982).

  1882 - "Lands along the tidewater (of the Siuslaw River) are mostly taken...." (Gazette, 1882).

  1890 - On February 2, a rain-on-snow-event triggered a large landslide down what is now called Slide Gulch, about two miles up-river from Mapleton. The river was temporarily dammed and sudden flooding occurred. Pioneers wrote of wading up to their necks in water to rescue loved ones, belongings, and livestock. Several lives were lost and homes, barns and livestock were washed away (Siuslaw Pioneer, 1948).

1893 - A subdivision of residential and business lots in Florence was recorded.

1894 - A map by Joseph Koch shows most land was claimed along the Siuslaw River bottoms as well as four miles up Sweet Creek, all the way up Knowles Creek, five miles up Hadsall Creek, and three miles up Bernhardt Creek (Map of Lane County, 1894). The initial development activity in these areas was the clearing of woodlands for pasture and crops.

1896 - The post office was established at Mapleton (Beckham et.al., 1982).

1902 - The post office was established at Swisshome (Beckham et.al., 1982).

1907 - The Siuslaw National Forest was established.

1910 - A record catch of 31,500 salmon seined from the Siuslaw River was brought to local canneries on November 10, 11, and 12 (The West, 1910).

1912 - Electricity comes to the City of Florence.

1928 - Florence had a population of 300 people and 100 homes. Cushman had a population of 200 people (Lomax, 1928).

1950 to 1960 - The Bonneville Power Administration (BPA) constructed the Lane-Wendsen 230KV line. The line generally followed Highway 126 for twenty-three miles through most of the analysis area. Numerous access roads were constructed and used to maintain the line.

1965 - A large slide moved out of Hollenbeck Canyon and hit Mapleton on January 28; roads were closed and buildings destroyed (Siuslaw News, 1965). The Forest Service Ranger Station was damaged.

4.1.2 Logging History

The following list describes some of the historical logging events. Based on stand data that records the year of origin for managed stands, Map 9 displays when areas were harvested.

1879 - The first sawmill was established near Florence (Siuslaw Pioneer). Initial logging was by teams of horses or oxen. Steam power arrived in the woods in the 1880's.

1880 to 1910 - Splash dams were used on Knowles Creek, "run-of-the-river" drives on the Siuslaw River, lower Sweet Creek, and lower portion of the creek flowing into South Inlet (Farwell, 1981).

1897 - There were four mills on the river and the lumber was being shipped by schooner to San Francisco. A boom was linked across the river seven miles below the head of tide to catch logs as they were floated down the Siuslaw River (The West, 1897).

1900 - The four mills had a combined capacity of 200,000 board feet per day (Farneil, 1979).

1890 to 1931 - Over 125 log brands were registered to drive logs on the Siuslaw River and its tributaries (Farwell, 1979).

1907 - The Siuslaw National Forest was established.

circa 1911 - The West (undated) reported that, "The numerous streams furnish an easy and inexpensive means of transporting logs to the lower river." "Logs above high tide were put in creeks to be carried downstream by high water in the winter." "The Phelps boys were blasting and removing obstructions from Wildcat Creek." Although Wildcat Creek is not in the analysis area, this points out logging methods used in the general area.

1913 - Assistant Forest Ranger Simmons reported logging methods in the North Fork area to be: "The method of logging now in use ... is to follow up some driveable stream and log only the readily accessible timber that can be reached by extending yarding lines out from a donkey engine placed along stream" (Simmons, 1913). It is reasonable to believe these same methods were used on similar lands logged in the analysis area during the same period.

1919-1925 - Most harvest during the early days was on private lands. Mapleton Ranger District records show that only 38,000 board feet was harvested from National Forest lands during this period (North Fork Siuslaw W.A., 1994).

1930-1950 - While donkeys continued to drag and cold-deck logs in the canyons, crawler tractors became the common method of transporting logs from the cold-decks to the river. Tractors operated both on the stream banks and directly in the streams (Holden, 1994). In the 1940s, only 115 acres of timber were harvested from National Forest lands.

1950-1959 - In the early 1950s, up-hill logging was initiated. This refinement brought about the construction of roads to ridge lines for convenient locations of spar trees and log landings. On National Forest lands, most sales were small sales to local individuals. Harvest was mostly cedar, scattered old-growth fir, and salvage of dead second growth timber (North Fork Siuslaw W.A., 1994). During this period, 1,629 acres of timber were harvested from National Forest lands.

1960-1969 - More efficient logging methods were introduced and timber harvest increased greatly on National Forest lands. There was more demand for National Forest timber and many independent loggers moved from private land timber sales to the National Forest. On National Forest lands this was the beginning of ridge-top road systems, large clearcuts, hot slash burns, and aggressive reforestation programs. It was also a time of numerous landslides, which originated both from the over-loading of steep slopes and headwall areas with sidecast road construction materials, and from within clear-cut units (North Fork Siuslaw W.A., 1994). During the 1960's, the increased emphasis on timber harvesting resulted in 4,470 acres of timber harvest on National Forest lands.

1970-1979 - The mid-and late-1970s brought about increasing demand for timber from the National Forest and resulted in increased timber prices. Concerns about damage to fish habitat brought about changes in road construction methods, skyline logging over sensitive areas, and the retention of conifer vegetation along streams and in headwall areas. Helicopter logging was introduced to limit road construction on sensitive soils (North Fork Siuslaw W.A., 1994). In the 1970s, 3,820 acres of timber were harvested from National Forest land.

1980-1988 - As lumber prices fell, companies could not afford to harvest the timber purchased at previously-high prices. The government provided five year contract extensions and later bought many of them back in exchange for designated penalties. The Mapleton lawsuit in 1984 curtailed new sales except for limited salvage and thinnings. Attempts to soften the impacts on local loggers resulted in legislation to permit some sales and defer others; this fueled an environmental controversy, legislative appeals, and industry and environmental gridlock (North Fork Siuslaw W.A., 1994). Although there were restrictions on timber harvesting, 2,910 acres of timber were harvested from National Forest land in the analysis area.

1988-1994 - During this period, some volume was "released" from appeal and other legal processes. A total of 1,176 acres of National Forest timber was harvested between 1988 and 1992. However, in 1993 and 1994, only 90 acres were harvested.

1995 to date - Mapleton District records indicate that no timber has been harvested from National Forest lands within the analysis area (McKinnis,1998).

1940 to 1994 - Between 1940 and 1994, approximately 14,800 acres of timber were harvested from Siuslaw National Forest and Bureau of Land Management lands within the analysis area (Table 9). Map 9 displays harvest history by stand origin.

Table 9. Acres of Timber Harvest Per Decade from Federal Land

	Decade					
	1940	1950	1960	1970	1980	1990
Forest Service	115	1,629	4,470	3,820	2,910	841
BLM	255	431	260	90	30	51
Total	370	2,060	4,730	3,910	2,940	892

4.1.3 Recreation

- The focus of recreation activity in the analysis area has changed little over time. Changes have occurred in the number of people using the area and the ease of transporting oneself to and through the area.

- There are three zones of recreation activity within the analysis area: 1) the ocean beach, dunes, lower estuary, and Florence urban area; 2) the Siuslaw River above the Highway 101 bridge to Austa; and 3) the forested uplands, mountains, and smaller drainages above the Siuslaw River.

The Beach and Urban Areas

- The attraction of the Pacific Ocean beach and its adjacent dunes is universal along the West Coast. Two miles of Heceta Beach form the western boundary of the analysis area. Lane County maintains two small recreation sites adjacent to the beach that provide picnic and camping areas, and beach access. The North and South Jetties provide fishing access. A narrow portion of the Oregon Dunes National Recreation Area lies on the south bank of the Siuslaw River below the Highway 101 bridge.

- The forested dunes behind Heceta Beach contain several rapidly expanding subdivisions that contain full- and part-time residences. The dunes east of Highway 101 in the Clear Lake area are used by off-highway-vehicles and other motorized recreation equipment. The Florence/Heceta Beach/Glenada area abounds with tourist facilities and has several marinas.

The Siuslaw River

- Recreation activity on the Siuslaw River east of the Highway 101 bridge is primarily directed at fishing for chinook salmon and steelhead. Currently, the fishing seasons in these waters are May 24 to November 30 for salmon and May 24 to March 31 for steelhead. Wild steelhead and sea run cutthroat trout must be released. Lane County and the Oregon Department of Fish and Wildlife (ODFW) maintain seven boat launch access areas along the river. There are several private marinas and docks available.

The Forested Uplands and Mountains

- Although there is some fishing in Sweet Creek, most of the recreation activity in the uplands is focused along or adjacent to the forest road system. Hunting for deer, elk, and bear is one of the more common recreation pursuits. Hunting seasons generally run from August 30 to November 30. As fewer trees are harvested on federal lands, game animals will become more difficult to locate in the dense forests. As a result, there may be more pressure to hunt on recently harvested areas on state or private industrial forest lands where the early seral stages provide better habitat and easier spotting.

- Along FS Road 48, four trailheads link three miles of trail along Sweet and Beaver Creeks. Eleven waterfalls and lush vegetation provide special interest. These are the only maintained trails in the analysis area.

- The nine-unit Archie Knowles Campground is located along State Highway 126, about four miles east of Mapleton. Many people drive forest roads just to "get out into the woods." The chance to see wildlife, photograph a pleasing scene, escape the heat, or play in an occasional snowfall bring many into the forest.

4.1.4 Landscape Aesthetics

- Prior to extensive logging, the visual condition of the landscape was controlled by fire, wind, and natural succession. These forces produced a landscape that had more variety in the structure of individual stands than can be found in the current replacement stands.

- The application of the Aquatic Conservation Strategy (ACS) as well as management direction for all land use allocations on National Forest and BLM lands will provide for more down material, a greater mix of species and age classes, and more snags. The management of visual resources on private lands in the analysis area may not meet these same objectives.

- The visual quality objectives for National Forest lands viewed from State Highway 36 are "Foreground - Partial Retention" and "Middleground - Modification." For State Highway 126, the visual quality objectives are "Foreground - Retention" and "Middleground - Partial Retention" (SNF Forest Plan, table IV-13). It appears that these objectives are being met (Johnson, 1997).

4.1.5 Beneficial Uses of Water

- The Oregon Department of Environmental Quality (DEQ) administers state and federal environmental laws including those addressing water quality. These laws are translated into action through the Oregon Administrative Rules (OARs) adopted by the Environmental Quality Commission (EQC). Chapter 340, Division 41 of Oregon Administrative Rules (OAR 340-41) provides a broad framework for protection of

water quality for each major river or drainage basin. Within this framework, water quality standards have been established to protect designated beneficial uses (DEQ, 1994).

- Water quality standards not to be exceeded, and the beneficial uses they protect in the Mid-Coast Basin, in which the Lower Siuslaw watershed is situated, are listed in OAR 340-41-242. Table 10 shows the beneficial uses of surface waters in the Lower Siuslaw watershed.

Table 10. Beneficial Uses of Surface Water in the Lower Siuslaw Watershed

Beneficial Uses of Mid Coast Basin Tributaries	Estuaries and Adjacent Marine Waters	Fresh Waters
Public Domestic Water Supply		X
Private Domestic Water Supply		X
Industrial Water Supply	X	X
Irrigation		X
Livestock Watering		X
Anadromous Fish Passage	X	X
Salmonid Fish Rearing	X	X
Salmonid Fish Spawning	X	X
Resident Fish and Aquatic Life	X	X
Wildlife and Hunting	X	X
Fishing	X	X
Boating	X	X
Water Contact Recreation	X	X
Aesthetic Quality	X	X
Hydropower		X
Commercial Navigation and Transportation	X	

4.1.6 Special Forest Products

- The forest has always been used for the products it produces. Native Americans made extensive use of the forest for herbs, food, building materials, fuel, and materials for clothing and baskets. The forest was an aisle in their market, and they made good use of it. Early settlers built log homes chinked with moss with a roof of split cedar shakes. As time passed, wood fueled everything from the kitchen range to steam donkeys.

- Currently, the watershed supplies a variety of small products to local residents. Fuel wood and mushrooms are the most commonly-sought items. A number of plants such as rhododendrons, sword ferns, and huckleberries are removed as nursery stock. Ferns, salal, and moss are also removed commercially as florist materials. In some cases, three-year area contracts are used to provide consistent management. An estimated twenty permits are issued annually within the analysis area (Kuskie, 1997).

- The USFS has entered into several agreements with industrial forest owners for cooperative road access and maintenance. These agreements generally provide for continued access through adjacent lands and the cooperative maintenance of roads that serve both ownerships. The following agreements are currently in force:

4.1.7 Transportation Systems

- The following list describes some of the historical transportation systems events.

  Late 1880s - construction of a road network started in the late 1800s. By 1975, 94 percent of the 558 miles of roads currently in the watershed had been built (Map 10). Road construction activities were virtually over by 1984 (Taylor, pers. comm., 1997). Most of the roads in the watershed were constructed between 1940 and 1970.

  1884 - A wagon road, started in 1876, was completed between the Lower Siuslaw River and the Willamette Valley (Lower Lake Creek, undated). Although there was a wagon trail to Eugene, the early residents along the river depended upon ocean-going schooners to bring supplies and take lumber and fish to market. Smaller craft plied the river to bring goods to the settlers. Fat-tired wagons followed the beaches, and rough trails led around the headlands.

  1894 - The map by Koch shows a wagon road following the north bank of the Siuslaw River from the east to "Seaton" near Walker Creek, and a wagon road six miles up Knowles Creek (Map of Lane County, 1894).

  1913 - A precinct map shows that the road was completed between Florence, Mapleton, and up-river (Precinct Map, 1913).

  1915 - The railroad was completed between Florence and Eugene (Lane County Historian, 1971). This event energized the lumber industry by opening new markets, and signaled the end of the lumber schooner and sea-going log rafts.

  1917 - Work initiated in 1892 by the U.S Army Corps of Engineers was completed on the north and south jetties at the mouth of the Siuslaw River (Willingham, 1958).

  1924 - The SNF map shows the following: a railroad line in place in its current general location; in Knowles Creek, a road from Mapleton to the top of drainage and a trail down the eastern side of Turner Creek; "minor or poor road(s)" three miles up

Sweet Creek and two miles up both Lawson and Hadsall Creeks; "fair to good" road from the North Fork up McLeod Creek and to the Siuslaw River by way of Rainrock (now Shoemaker) Creek (SNF Map, 1924).

1925 - The U.S. Army Corps of Engineers initiated work to extend the river entry project five miles up the river to Florence. Work included "snagging, boulder and debris removal, dredging, sluicing and revetment." The project was completed in 1930 (Willingham, 1958).

1930 - An "all weather road" was completed between Acme (now Cushman) and Mapleton (Siuslaw Pioneer, 1985).

1936 - A highway bridge replaced the ferry across the Siuslaw River at Florence.

1938 - A mail boat started delivery to points along the Lower Siuslaw River and continues until 1958 (Siuslaw News, 1958).

1941 - The Metsker Atlas of the area provided the following: Knowles Creek Road unchanged from 1924; paved road from Florence to Swisshome; County Road 6070 to the North Fork in current location; Sweet Creek Road system reaching to the top of Fall Creek and east to Ryan Creek; roads three miles up Lawson Creek and two miles up Karnowsky Creek.

1960 - The tunnel east of Mapleton on State Highway 126 was opened.

1985 - The U.S. Army Corps of Engineers completed the river entry project. A 400-foot spur was extended on both jetties. Over 9,000 tons of rock were removed from the Mapleton quarry for the project (COE, 1997).

Current Road System

Public Access

- The Forest Access and Travel Management Guide (ATM) provides direction for national forest roads in the analysis area. This is a dynamic process that responds to changing public, economic, and resource protection and management needs. Currently, there are 63 miles of roads designated as ATM roads in the analysis area (Map 11).

- In September 1994, the ATM was revised. This process included considerable agency, industry, and public review and comment. The discussion focused on the concept of managing public roads and not on specific road systems or areas (Mummey, 1998). There was a wide range of opinion concerning how many roads should remain open. Commercial forest products users desired that forest roads

remain open for easy access to their contract areas. Some hunters wanted roads for access, while others wanted most roads to be closed to provide better habitat. The forest industry desired continued access to timber sales and to their lands.

- Some local community leaders have had discussions about a Crest of the Coast Range Scenic Byway. Although such a possible route would follow existing Forest Service system roads, some road improvement may be required

- Public access to BLM lands in the eastern portion of the analysis area appears to be adequate. The 18-9-25.1 road into the head of Waite Creek is gated, but foot access is allowed. A gate is in place at the junction of BLM road 18-8-7 and County road 5020. However, most of the area can be reached by other roads. The BLM has not completed an ATM plan for their road system in the eastern portion of the analysis area. Currently, each road has its own established maintenance level (Wold, 1997).

Access to Bonneville Power Lines

- There are three BPA power lines in the analysis area:

  1. The Lane-Wendson line crosses federal, State of Oregon, and private lands along the north side of the Siuslaw River from Wendson to Mapleton, and in the Knowles Creek, Turner Creek, and Rock Creek areas.
  2. The Toledo-Wendson line crosses national forest and private lands north of Wendson and into the North Fork watershed.
  3. The Wendson-Tahkenitch line crosses private and national forest lands in the Bernhardt Creek area.

- Access for line maintenance is provided by a number of short, low-standard roads off of Highway 126 as well as USFS, and BLM road systems. The BPA needs continued year-round access to all roads currently being used to provide adequate line maintenance. The USFS is currently reviewing access requirements with the BPA.

Access to and through Forest Industry Lands

- The Forest Service has entered into several long-term, cooperative road easements with the John Hancock Mutual Life Insurance Company. These easements generally provide for continued access through adjacent National Forest and John Hancock lands and the cooperative maintenance of roads that serve both ownerships. An estimated 25 miles of road are involved in the Bald Mountain, Knowles Creek, and Hadsall Creek areas. The Access and Travel Management Map includes locations of the roads involved.

Access to Private Industrial Forest Lands

- The USFS has entered into several agreements with industrial forest owners for cooperative road access and maintenance. These agreements generally provide for

continued access through adjacent lands and the cooperative maintenance of roads which serve both ownerships. The following agreements are currently in force (Map 30).

Road Conditions

- There is a total of 558 miles of roads in the watershed, equating to a total road density of 3.2 miles per square mile in the analysis area (Table 11). The Florence subwatershed contains the most road miles. The three highways in the watershed, U.S. Highway. 101 and State Routes 36 and 126, contribute significantly to road densities in the subwatersheds they bisect. The current ATM road density equates to approximately 0.4 miles per square mile.

- A majority of the roads in the watershed occur on the upper third and lower third slope position, many being located on ridgetops or in valley bottoms. Fewer roads are located on midslope positions. There are about 58 miles of roads on floodplain landforms. Most of the mileage (60 percent) is comprised of segments of state highways or county roads along the mainstem Lower Siuslaw River, Knowles Creek, and Turner Creek. However, arterial county, Forest Service, and private road segments also occur along Beaver, Hadsall, Hand, Karnowsky, Lawson, and Sweet Creeks and the South Inlet.

Table 11. Road Miles and Densities by Subwatershed*

Subwatershed	Miles	Density (miles per sq. mile)
Barber	6.8	1.4
Berkshire	27.5	4.6
Cedar	26.1	3.7
Cox Island	10.4	4.0
Divide	48.1	3.5
Upper Divide	20.2	5.0
Florence	74.8	4.2
Hadsall	19.3	2.3
Hand	42.7	3.6
Hoffman	10.7	2.5
Hood	6.9	2.0
Knowles	16.5	2.9
Upper Knowles	30.5	3.0
Lawson	14.6	2.4
Lower Sweet	22.1	3.8
Meadow	13.7	1.6
San Antonio	23.2	4.3
Siboco	20.8	3.2
Thompson	42.7	3.6
Tilden	20.3	1.9
Turner	18.5	3.1
Waite	17.3	3.0
Walker	24.6	3.3

* Rounded to the nearest tenth.

- The conditions of the road network in the watershed have been appraised by several assessment efforts. The first, a Road Condition Assessment (RCA) conducted in 1997 for the USFS by an independent contractor identified sections of roads that exhibited drainage, stability, or erosion problems (Map 12, USDA, 1997a). Largely a field reconnaissance, this assessment located and characterized sites on roads where some kind of drainage or erosion problem, such as a plugged culvert or a slumping section of road prism, is occurring. The assessment did not survey all roads within the watershed; it primarily surveyed USFS roads. However, some BLM, state, and private roads were evaluated, if they accessed in-holdings within the Siuslaw National Forest Boundary and were open. Many roads located on non-Forest Service land in the eastern portion of the watershed were not surveyed. For details of the RCA see Appendix B.

- The second, according to the Mapleton Ranger District roads manager, Eli Adkisson, identifies sections of road that consistently require annual maintenance and repair due to similar types of problems as mentioned for the RCA (see Appendix B; chronic road maintenance). Finally, a inventory of landslides that occurred during the 1996 flood identifies slides that were deemed to originate from a road (USDA, 1996).

- Prior to 1975, many of the roads in the watershed were constructed on steep slopes (sidecast roads) and construction specifications did not require compaction of fill material (Map 13). Termed "sidecast" roads, they may have unstable fill slopes that could be chronic road maintenance problems or sources of landslides. It is estimated that 85 percent of USFS roads, 90 percent of BLM roads, and 85 percent of roads on state lands were constructed before 1975.

- The RCA identifies about 7 miles of road in disrepair (Table 12, and Appendix B). All except 0.2 mile of these road problems exist on sidecast roads. All of the currently designated ATM routes are sidecast roads. Furthermore, all of the segments identified by District personnel as chronic road maintenance problems occur on sidecast road segments, (about half are on ATM routes). The landslide inventory of 1996 indicates that there were 47 road related slides, and all but 5 originated from sidecast roads (Appendix B). Four of five slides originated from BLM roads constructed after 1975, and the RCA did not inventory them. Seven slides mapped in the 1996 flood assessment occurred on ATM roads.

- The assessment also surveyed 131 stream crossings and identified 4 plugged and 32 partially plugged culverts. All of these culverts are on sidecast roads. In addition, the plugged culverts are on USFS roads, two of which occur on roads designated in the ATM plan. Similarly, 29 of the 36 problem culvert sites occur on ATM roads.

- The road and culvert problem sites are evenly distributed between the upper, mid, and lower slope positions. Most of the fill failure and landslide problem sites occur on the midslope and ridgetop sidecast roads. Most of the culvert problem sites occur on the midslope and valley bottom positions.

Table 12. Road Condition Assessment Results, Miles of Problem Sites by Ownership (USDA, 1997a)

Owner	Culvert Failure	Erosion	Fill Failure	Landslide
Forest Service	0.00	0.30	0.93	0.16
BLM	0.04	1.84	0.00	0.00
State	0.00	0.00	0.02	0.01
Industrial Private	0.00	0.15	1.69	0.03
Other Private	0.00	0.00	0.01	0.00
Out of Watershed*	0.01	0.00	1.73	0.20
Total	**0.05**	**2.30**	**4.38**	**0.40**

* Select routes and ATM roads on Forest Service land, that provide primary access across the watershed boundary.

Note: Private, state, and BLM land in the eastern and far western portions of the watershed were not surveyed.

- Of the roads that occur on floodplain landforms, the RCA identified 4 culverts that are plugged. They are located on the 4880 and 4800-831 roads. Two are on USFS land while the others are on private land. The 1996 flood assessment mapped 12 landslides that damaged road segments in floodplains. Furthermore, the District Roads Manager identified road segments in the floodplains of Beaver, Hadsall, and Sweet Creek that are chronic maintenance sites.

- A slope stability analysis, termed the Berkeley model, was conducted to assess the risk of slope failures in the watershed (Map 14). Overlaying the model with the roads layer produces an indication of road segments located on unstable slopes as defined by the model (Table 13).

Table 13. Miles of Road by Berkeley Slope Stability Model Rating (Map11)

	Stable	Moderately Stable	Unstable	Out of Range
All Roads	538.72	14.39	3.88	1.01
ATM Roads	62.33	0.51	0.12	0.04

- There are approximately 5 miles of roads on slopes designated by the Berkeley model as having a high landslide risk. This includes roads on slopes designated by Berkeley as being "out of range", a risk category that is inferred here to relate to very steep (>80 percent) slopes or cliffs. Virtually all of the ATM routes classified as unstable are sidecast roads. Similarly, about 98 percent of all roads in the watershed classified as unstable, or out of range, are sidecast roads.

- Comparing the locations of road-related slides mapped in the 1996 flood assessment with the locations of Berkeley-rated unstable slopes suggests that the model may be a weak predictor tool for road applications. Of the 47 road-related slides mapped in the 1996 assessment, Berkeley rated the same slopes as moderately stable on 4 sites, and high on one other. However, this may not accurately reflect the usefulness of Berkeley to predict unstable roads since many road-related slides are a result of a human disturbance that exacerbates or induces unstable conditions above inherent slope stability.

- Most of the roads that occur on slopes rated by Berkeley as unstableare found in the in Cedar, Hadsall, Upper Knowles, and Walker subwatersheds. The highest incidence of Berkeley -rated unstable roads occurs in the San Antonio and Waite subwatersheds. The latter two have not had a RCA conducted on most of the roads. Consequently, it is difficult to determine how well the Berkeley ratings apply to these road segments.

- In contrast, comparing the proximity of unstable road sites identified in the RCA to Berkeley stability ratings results in somewhat of a weak correlation between the two. Berkeley tends to rate many ridgetop locations as stable, presumably due to some of the model parameters which delineate slope shapes. However, there are numerous ridgetop roads identified as having stability problems. Furthermore, unstable road segments identified by the RCA are predominately assessed by Berkeley as occurring on moderately stable slopes. As a result, it appears that the RCA is a more accurate method of identifying unstable road conditions.

4.2 EROSION PROCESSES - LANDSLIDES

- The reference rate, or frequency at which landslides occur under natural conditions, has not been determined for this watershed. However, mapping of landslides associated with the flood of 1996 resulted in 200 landslides tallied in the watershed, 71 (36 percent) of which were identified as originating from unmanaged stands (termed "In-Forest" in the 1996 assessment). These slides can be considered representative of "natural" slide occurrences associated with flood and high precipitation storm events (USDA, 1997).

- Slopes are generally greater than 60 percent in the mountains of the watershed (Map 14a). All of the subwatersheds, with the exception of Florence and Siboco, have more than two thirds of their area dominated (greater than 50 percent) by slopes exceeding 60 percent. Less than one third of the entire watershed has slopes below 30 percent. These slopes occur primarily on the coastal terrace in the western portion of the watershed. Slopes in the watershed were analyzed using the Berkeley Slope Stability model to predict the potential risk of landslides in the watershed. The model does not predict exactly where or when landslides will occur; however, it is useful in identifying where landslides are most likely to occur. The model utilizes digital elevation and soil data from soil surveys, along with a rain simulation model, to evaluate the risk of landslides on slopes throughout the watershed (Montgomery and

Dietrich, 1988). The model stratifies the landscape into areas of relative landslide risk potential, and provides the location and extent of slopes throughout the watershed rated as potentially unstable by the model parameters (Table 14).

Table 14. Berkeley Slope Stability Ratings

Risk Category	Area	
	Acres	Percent
Low	66,619	60
Moderate	32,328	29
High	10,251	9
Out of Range	2,283	2
Total	**111,481**	**100**

- The predominance of extreme and high risk categories are estimated to occur in steep first order drainages, headwall zones, and streams or rivers adjacent to escarpments in the eastern two thirds of the watershed (Map 14). The "out of range" category represents slope angles that exceed angles representative of debris torrent mass wasting processes modeled by Berkeley (Montgomery and Dietrich, 1988).

- A comparison of the landslides mapped in the 1996 Flood Assessment with the Berkeley stability ratings map provides some validation of the Berkeley model as applied in this watershed (Table 15). Approximately 71 percent of the 1996 slides that occurred on slopes within the model's range were rated as unstable by Berkeley. Four percent of the 1996 slides occurred on slopes rated stable by Berkeley. Consequently, it appears that the Berkeley model is somewhat accurate in rating relative slope stability in this watershed.

Table 15. Number of Mapped Slides in Relation to Berkeley Stability Ratings*

Slide Origin	Berkeley Rating			
	Stable	Moderately Stable	Unstable	Out of Range
Clearcut Harvest	1	6	38	5
Road Associated	1	7	17	22
In-Forest	3	12	25	18
Total	**5**	**28**	**80**	**45**

* Slide origin sites were overlayed onto the Berkeley map.

- It is well documented by both research efforts and other watershed analyses conducted in the Coast Range, that landslides are mechanisms for delivering large woody debris (LWD), rock and gravel, and sediment into stream systems which provides habitat components to the aquatic and riparian environment. Furthermore, it is well known that certain human disturbances can affect the composition, frequency,

magnitude, and distribution of landslides. Consequently, when considering the degree of human disturbance in the watershed, it is inferred that landslide occurrences have been altered.

- Landslides in the watershed believed to be partly, or wholly, induced by human disturbances (i.e., originating from roads or clearcuts) were mapped after the flood of 1996. Of the 200 slides inventoried, 78 (39 percent) were identified to originate from clearcut harvest units, while 51 (25 percent) were identified to originate from roads (USDA, 1997). A comparison of slides that occurred during the 1996 flood suggests that since 64 percent of all slides inventoried that year originated on slopes affected by human disturbances, natural slide frequency in the watershed may be elevated to some degree. However, this conclusion is not necessarily reflective of the current trend of landslide frequency. It is not known whether slide frequency trends are on the rise. It is possible that slide frequency is decreasing from elevated rates attributed to forest management techniques indicative of practices 20 or more years ago.

4.3 STREAM TEMPERATURE

- There is no existing water quality data to document pre-European or reference conditions in the watershed.

- The DEQ reports on the condition of State waters in the Biennial Water Quality Status Assessment Report, also known as the 305(b) report because section 305(b) of the Clean Water Act requires the state to produce the report and submit it to the Environmental Protection Agency (EPA) every two years. The most recent 305(b) report was issued in April, 1994. When analysis of a particular water body indicates that State water quality standards are not met, the water body is listed on the 303(d) list. Within the April, 1994 305(b) report, the entire Siuslaw River was listed on the 303(d) list due to exceeding water temperatures during the summer months.

- The current water temperature standard prohibits, or discourages human-caused, measurable increases in temperature in a basin for which salmonid fish rearing is a designated beneficial use, and in which surface water temperatures exceed 64°F. Data collected from five streams within the watershed exhibited summer water temperatures that exceeded the state standard (Table 16).

Table 16. Stream Temperature for Summer 1996 in the Lower Siuslaw Watershed.

Stream	Station #*	Dates Deployed	7-Day Ave. Max. Temp. (°F)	7-Day Dates	Longest Consecutive Days >64°F	Total Days >64°F	Highest Max. Temp. (°F) and Date Recorded	State Standard (64°F) Exceeded? (Y/N)
Divide	902526	7/2-10/11	62.8	7/21-27	1	1	77.2 (7/2/96)	N
Fall	903067	6/27-10/2	62.8	7/24-30	9	13	66.6 (7/13/96)	N
Hoffman	902527	6/26-10/7	68.8	8/21-27	55	55	70.5 (8/22/96)	Y
Lower Karnowski	1355	6/26-10/7	64.5	8/11-17	5	28	68.4 (9/9/96)	Y
Lower Knowles	1358	7/1-10/3	75.6	7/21-27	16	60	77.2 (7/23/96)	Y
Mid Knowles	1936	7/1-10/3	71.1	7/21-27	14	56	72.3 (7/25/96)	Y
Upper Knowels	1938	7/1-9/30	64.1	7/23-29	3	4	65.8 (7/26/96)	Y
Upper Sweet	1352	6/27-10/2	62.8	7/23-29	0	0	63.5 (7/24-25/96)	Y
Walker	1351	7/9-10/21	67.3	7/22-28	11	30	75.4 (7/9/96)	Y

* Location of stream temperature monitoring stations shown on Shade Map

4.4 AQUATIC SPECIES AND HABITAT

4.4.1 Reference Conditions: Fish Species

- Historically, distribution of anadromous salmonids was probably similar to current distribution.

- Although similar in distribution, historically the Siuslaw Watershed supported high numbers of anadromous salmonids, including chinook and coho salmon, steelhead, and sea-run cutthroat trout. This assumption can be supported by commercial catches of coho salmon in the estuary near Florence.

- The Siuslaw watershed has approximately 514 miles of stream where coho salmon spawn (ODFW, 1997). From 1889 to 1896, historic coho salmon harvest in the Siuslaw River averaged 83,400 fish annually (U.S. Fish Commission, 1897), equaling a run of at least 125,100 fish (based on a 40 percent exploitation rate for a river gillnet fishery [Mullen 1981]), or an average of 243 coho spawners per mile of stream. However, peak adult coho salmon counts, which generally represent about half the total run, have decreased dramatically since the 1950s. Peak counts in Panther Creek averaged about 14 coho spawners per mile of stream from the 1950s

through the 1980s. Counts in 1996 averaged only four coho spawners per mile of stream in Hadsall, Hoffman, Rock, and San Antone Creeks (Jacobs, pers. comm., 1989).

- A more recent indicator of changes in coho salmon spawning abundance in the Lower Siuslaw River is in Panther Creek, tributary to Lake Creek. Peak counts in Panther Creek were about 21, 8, 12, and 15 coho adults/mile, respectively, for the 1950s, 1960s, 1970s and 1980s (Jacobs, 1989).

4.4.2 Current Conditions: Fish Species

- Current salmonid distribution, probably similar to historic distribution, includes about 130 miles of stream in the Lower Siuslaw River used by combinations of anadromous salmonids (chinook, coho, chum salmon, steelhead, and sea-run cutthroat trout) and another 51 miles used by resident cutthroat trout (Map 15 and Table 17).

- The lower mainstem Siuslaw River is generally used as a migration corridor for anadromous salmonids, with some fall chinook salmon spawning occurring in the last few miles of the watershed boundary.

- Pacific lamprey is probably found in all stream reaches containing anadromous salmonids. Sculpin are found in most, if not all, stream reaches occupied by either sea-run and/or resident cutthroat trout. Speckled dace have been found in Hadsall and Sweet Creeks and probably reside in the mainstem Siuslaw River (above tidewater) and lower reaches of all larger tributaries. Western brook lamprey have been found in Munsel Creek.

- Current distribution of salmonids in the Lower Siuslaw watershed (that differs from the Forest Service GIS layer), was determined using: previous habitat and fish population inventories conducted on streams in the watershed; relative stream size and the upstream watershed area (for resident cutthroat trout); and information from personal communication with Paul Burns (USFS), Charlie Dewberry (PRC), Neil Armantrout (BLM), and George Westfall, Bob Buckman and Will Biedler (ODFW), and Forsberg (1994).

- Including the mainstem and side channels of the Siuslaw River, fall chinook salmon are currently found in 74.4 miles (about 12 miles are used only by fall chinook salmon), chum salmon in 21.5 miles, coho salmon and sea-run cutthroat trout in 128.9 miles, steelhead in 126.7 (steelhead miles are less than coho because Munsel Creek contains only coho salmon and coastal cutthroat), and resident cutthroat trout in about 181.4 miles of stream (Table 17). The only identified natural barrier for anadromous fish is Sweet Creek Falls, about 8.0 miles upstream from the mouth of the Siuslaw River.

Table 17. Anadromous Salmonid Distribution in the Lower Siuslaw Watershed.

Stream	Miles Of Stream Used By Salmonids					
	Chinook Salmon	Chum Salmon	Coho Salmon	Winter Steelhead	Sea-run Cutthroat	Resident Cutthroat
Barber	1.0		3.9	3.9	3.9	5.5
Beech			0.5	0.5	0.5	0.5
Berkshire			0.3	0.3	0.3	1.2
Brush	0.1		0.3	0.3	0.3.	3.5
Cleveland			1.3	1.3	1.3	1.3
Demming			2.0	2.0	2.0	4.0
Divide		1.0	3.7	3.7	3.7	7.0
Duncan Inlet	3.0	3.0	3.0	3.0	3.0	
Hadsall	1.0		4.5	4.5	4.5	12.0
Hanson			1.5	1.5	1.5	1.5
Hoffman			3.0	3.0	3.0	10.0
Hollenbeck			1.5	1.5	1.5	1.5
Karnowsky			3.0	3.0	3.0	9.0
Knowles and tributaries	10.0		15.5	15.5	15.5	35.0
Lawson			4.8	4.8	4.8	10.0
Mainstem Siuslaw River	46.6	16.0	46.6	46.6	46.6	46.6
Marlin			0.0	0.0	0.0	1.0
Mason			0.0	0.0	0.0	1.0
Meadow			1.9	1.9	1.9	1.9
Munsel			2.9	0.0	2.9	2.9
Neilson			0.0	0.0	0.0	0.5
Old Man			0.0	0.0	0.0	1.0
Pat			1.5	1.5	1.5	1.5
Peterson			0.0	0.0	0.0	1.0
Rock			1.8	1.8	1.8	2.5
San Antone			1.5	1.5	1.5	3.0
Saunders			0.0	0.0	0.0	0.5
Schoolhouse			1.0	1.0	1.0	1.0
Shoemaker			1.0	1.0	1.0	1.0
Smith			0.0	0.0	0.0	0.5
South Inlet (Slough)	2.7		3.7	3.7	3.7	3.0
Sweet and tributaries	9.0	1.5	9.0	9.0	9.0	39.0
Thompson			2.2	2.2	2.2	2.2
Tilden			1.4	1.4	1.4	1.4
Turner	1.3		1.3	1.3	1.3	5.5
Waite	0.7		2.0	2.0	2.0	4.0
Walker			2.3	2.3	2.3	5.0
Totals	**75.4**	**21.5**	**128.9**	**126.7**	**128.9**	**181.4**

- Man-made barriers that stop or hinder passage of adult and/or juvenile salmonids, include culverts on Tilden, Munsel, Petersen, and Thompson Creek (ODFW, 1997) (Map 16). On unnamed tributaries of Thompson Creek, four of the five identified culverts were low in priority (upstream from anadromous fish habitat) and one culvert was medium in priority (possible barrier for steelhead). The culvert on the 5020 road on Tilden Creek was identified as medium priority, possibly hindering passage of coho salmon, steelhead, and sea-run cutthroat trout. Culverts identified as high priority (limiting or preventing access to high quality fish habitat) were on the 5034 road at the mouth of Petersen Creek and the 5260 road on Munsel Creek. Both culverts restrict passage of coho salmon and sea-run cutthroat trout.

- All salmonid species, except fall chinook salmon and resident coastal cutthroat trout, are at depressed levels. The ODFW has identified anadromous fish runs in the Siuslaw River as depressed for coho salmon; healthy for fall and unknown (maybe not a viable population) for spring chinook salmon; and depressed for winter steelhead. From 1981 to 1990, winter steelhead populations were well below the 20-year average (1971-1990) for nine of ten years (ODFW, 1992). The depressed status for anadromous salmonid runs in the Siuslaw River Basin has resulted from a combination of factors including habitat degradation, excessive harvest, hatchery influence, and poor ocean conditions.

- Catches of sea-run cutthroat trout, identified as depressed, from 1992-1994 in the Siuslaw River were less than 10 percent of those in the late 1960s, with wild trout declining by about 99 percent (Hooton, 1997).

- In the Siuslaw River, Nehlsen et al. (1992) listed wild coho salmon at moderate risk of extinction due to modification of habitat, and winter steelhead as special concern due to interactions with hatchery fish.

- Random counts in the1996-97 spawning season in the Lower Siuslaw Watershed revealed 3, 11, 3, and 1 coho adults/mile of stream in Hadsall, Hoffman, Rock and San Antone Creeks, respectively (Steve Jacobs, pers. comm., 1989).

- Estimates of current salmonid production in the Lower Siuslaw Watershed are from Knowles, Divide and Hadsall Creeks. In Knowles Creek, outmigrant trap data from 1985-1995 estimated the watershed annually produced between 0.55 and 20.6 coho smolt/mile and 0-3.28 steelhead smolt/mile (Dewberry et al., in press). In 1996, juvenile sampling in Divide and Hadsall Creeks found 78 and 29 coho, 0 and 17 steelhead, and 48 and 27 cutthroat trout, respectively (ODFW, 1996).

4.4.3 Reference Conditions: Fish Habitat

- For historic aquatic habitat and riparian reserve conditions in the Lower Siuslaw River watershed, Brush Creek probably is close to reference conditions. Most of Brush Creek's uplands and riparian reserves are mature conifer forest.

- Historically, stream channels in the Lower Siuslaw Watershed were dominated by large accumulations of LWD.Beavers were numerous in transport and depositional (response) channels (USDA, 1996).

- Historically, key salmonid production hotspots were probably the same as current areas, although the productive capabilities of these areas have been dramatically reduced because of logging activities, roads, and agricultural activities (livestock grazing). These activities have reduced LWD, pool quality and quantity, off-channel habitat, and water storage in these areas.

- Large woody debris and beaver dams were the most important components for creating and maintaining fish habitat diversity and quality, by trapping sediments, providing instream cover, creating pools and off-channel habitat, storing water during low flow summer months, and supporting aquatic invertebrate production.

- Old-growth coniferous riparian areas provided a long-term, continuous source of LWD and, along with a mature deciduous overstory, provided shading to prevent high water temperatures. However, the main source of LWD in hotspots originated from debris torrents in smaller transport and source channels that were aligned by old-growth conifer forest.

4.4.4 Current Conditions: Fish Habitat

- All watersheds, the mainstem Siuslaw River, and the estuary within the Lower Siuslaw Watershed have been impacted, to varying degrees, by forest management, residential and commercial development, and agricultural activities including timber harvest, road construction, stream cleaning, splash damming, log drives, valley settlement, estuary modification, and livestock grazing (Table 18; USDA, 1994).

- Karnowsky, South Inlet, and Lawson Creeks have tide gates (little available information exists on their current conditions) which interfere and impact water and fish movement.

- Lawson, Karnowsky, Hoffman, Sweet and Walker Creeks have grazing/riparian habitat impacts.

- Sweet, Turner, Thompson, Smith, Rock, Meadow, San Antone, and Shoemaker Creeks have road/culvert problems (culverts on mainstem reaches are not complete barriers).

- Meadow, Hadsall, Knowles, Waite and Turner Creeks have excessive logging impacts.

- Divide, Hadsall, Walker, Berkshire, Sweet and tributaries, Lawson, Karnowsky, Meadow, Schoolhouse and Thompson Creeks have been impacted by stream cleaning. Knowles, lower Sweet, and South Inlet creeks have been impacted by splash damming, and Berkshire Creek has been impacted by municipal water withdrawal.

- There is no specific information on impacts to aquatic resources for Peterson, Old Man, Brush, Barber, Tilden, Hollenbeck, Saunders, Neilson, Hanson, and Munsel Creeks.

Table 18. Known General Impacts to Streams in the Lower Siuslaw Watershed.

Stream	Causes for change in stream condition and/or fish production							
	Water diversion	Tide gate	Grazing in Riparian	Roads and Culverts	Logging in Riparian	Stream cleaning	Splash dams	Railroad and Dikes
Mainstem Siuslaw River			X	X		X		X
South Inlet		X		X			X	
Demming			X	X				
Lawson		X	X		X	X		
Karnowsky		X	X		X	X		
Peterson								
Hoffman			X		X			
Mason								
Sweet and tributaries			X	X		X	X	
Marlin								
Hadsall				X	X	X		
Knowles and tributaries				X	X		X	
Old Man								
Brush								
Barber								
Turner				X	X			
Waite					X			
Rock				X				
Meadow				X	X	X		
Smith				X				
San Antone				X	X			
Beech				X				
Pat				X				
Tilden								
Cleveland					X			
Thompson				X		X		
Shoemaker				X		X		
Walker			X	X		X		
Berkshire	X				X	X		
Hollenbeck								
Saunders								
Neilson								
Divide				X		X		
Hanson								
Schoolhouse						X		
Munsel								

Key: X = Identified impacts based on literature or personal communication. Blank spaces indicate that there was no available information for this iteration to determine a specific impact

- Determinations of current salmonid habitat conditions on about 22 miles of stream in the Lower Siuslaw watershed were based on aquatic habitat inventories (Table 19). Current habitat conditions on another 100 miles of stream were based on qualitative, objective information from personal communication with Paul Burns (USFS), Charlie Dewberry (PRC), Neil Armantrout (BLM), and George Westfall, Bob Buckman and Will Biedler (ODFW).

Table 19. Stream Habitat Inventories Conducted in the Lower Siuslaw Watershed

Stream	Years	Length (miles)	Most Recent Type of Inventory
Barber Creek	1951	2.8	USFS standard survey
Brush Creek	1952, 1979	1.7	USFS standard survey
Cedar Creek	1957, 1989, 1992, 1997	2.3	Modified R6
Divide Creek	1952, 1975, 1977, 1997	3.2	Modified R6
Fall Creek	1997	1.7	Modified R6
Gravel Creek	1979	1.0	USFS standard survey
Hadsall Creek	1975	4.7	ODFW
Hand Creek	1978	1.7	USFS standard survey
Hoffman Creek	1980,1990,1996	0.2	Modified R6
Hood Creek	1952	0.3	Oregon Fish Commission
Karnowsky Creek	1951, 1977,1990	1.5	USFS standard survey
Knowles Creek	1952, 1975, 1993, 1996	0.0	PNW- R6 modified
Lawson Creek	1954, 1980,1990	5.2	USFS standard survey
S.F. Sweet Creek	1979	0.5	USFS standard survey
Schoolhouse Creek	1953	0.8	Oregon Fish Commission
South Canyon Creek	1982	0.7	USFS standard survey
South Inlet	1992	0.2	USFS standard survey
Sweet Creek	1949, 1953, 1975, 1978-9, 1997	1.5	Modified R6
Thompson Creek	1950, 1977,1997	2.4	Modified R6
Walker Creek	1978, 1996	0.8	Modified R6
Totals		**33.2**	

- Of the 33 miles of stream with inventory information, current habitat condition on 12 miles of stream was based on modified USFS R6 inventory data collected after 1990 on 8 streams and 14 stream reaches (Table 20). Current habitat condition on another 10 miles of stream (Lawson, Karnowsky, Gravel, S.F. Sweet and Brush Creeks) was based on inventories conducted to 1990 and were more of a subjective descriptions of various habitat components.

Table 20. Current Stream Habitat Conditions Based on R6 Stream Inventory Data for Selected Habitat Variables in the Lower Siuslaw Watershed

Streams			Habitat Characteristics								
	Reach	Length (miles)	Gradient (%)	Wetted width (ft)	Pool area (%)	Deep pool area (%)	Large woody debris (pcs/mile)	Substrate		Riparian vegetation	
								% sand	% bedrock	Class	Type
Cedar	1	1.16	3	9	41	5	4	10	46	ST	HA
	2	1.09	7	5	26	0	17	18	7	ST	HA
Divide	1	1.33	3	12	37	2	7	20	25	ST	HA
	2	1.91	2	5	57	15	8	36	3	SS	SS
Fall	1	1.71	3	6	69	55	4	58	4	ST	HA
Hoffman	4	0.16	7	4	60	0	37	15	10	ST	HA
Sweet	1	0.62	5	37	44	36	2	2	50	ST	CD
	3	0.56	4	22	57	12	2	13	20	LT	CD
	4	0.37	2	20	43	21	0	16	23	LT	CD
Thompson	1	0.94	2	8	35	3	4	28	0	LT	HA
	2	1.43	3	5	35	3	4	25	1	ST	HA
Walker	1	0.06	2	11	30	0	0	21	11	ST	HB
	3	0.56	2	7	46	0	16	22	1	ST	HA
	4	0.22	5	4	33	0	0	17	2	ST	HA
Knowles	Data Not Provided for This Iteration										

Key: SS = shrub/seedlings, ST = small trees (8"-21" DBH),
LT = large trees (21"-32" DBH), HA = hardwood/alder
CD = conifer (d.fir) HB = hardwood/big-leaf maple

- The condition of aquatic habitat in the watershed was determined by comparing current habitat data from stream surveys to parameters defined by the National Marine Fisheries Service (NMFS, 1996) that are indicators of habitat conditions in Coastal Oregon streams (Appendix G for comparison chart).

- Based on all available habitat information, the current conditions for about 122 miles of stream in the Lower Siuslaw watershed are: about 4 miles in functional (good) condition; 86 miles in partially (fair) functional condition; and 32 miles in non-functional (poor) condition (Map 17; Table 21).

- Streams that are in fair condition or poor condition have been impacted from changes in water regimes, water quality (temperature and sediment), LWD, and riparian zones.

- Streams considered to be in good condition have intact old growth coniferous riparian zones and stable, relatively undisturbed channels that have not been impacted by human activities (see Table 21 for a more detailed description of functioning, functioning at risk, and non-functioning streams).

- Most stream reaches, with the exception of private forest and agricultural land, are probably in a very slow upward trend since major effects from logging and mature riparian overstory removal have already occurred. These areas are now protected under the Northwest Forest Plan on federal land.

Table 21. Current Fish Habitat Condition in the Lower Siuslaw Watershed

Stream	Stream Habitat Condition (Miles)		
	Functional	Partially functional	Non-functional
Barber		1.4	1.4
Beech		0.5	
Berkshire		0.3	
Brush	2.0		
Cleveland			2.0
Demming		2.0	
Divide	0.3	1.9	1.3
Hadsall		0.5	4.5
Hansen		1.0	
Hoffman		1.0	2.0
Hollenbeck		1.5	
Karnowsky			2.2
Knowles Creek & trib's	0.8	4.3	5.9
Lawson		1.0	3.5
Mainstem Siuslaw River		46.6	
Meadow	0.0		2.0
Munsel		3.0	
Old Man		0.6	
Pat		1.5	
Rock		1.8	
San Antone		2.0	
Saunders		0.5	
Schoolhouse		1.0	
Shoemaker		1.0	
Smith		0.5	
South Inlet (Slough)		2.0	
Sweet Creek & trib's		8.8	2.2
Thompson	0.6		1.5
Tilden		0.5	0.5
Turner		0.7	0.8
Waite	0.7	0.8	
Walker			2.0
Totals	**4.4**	**85.7**	**31.8**

- Map 17a displays stream gradient categories based on Montgomery and Buffington classification scheme (Montgomery and Buffington, 1993). The map was generated using a digital elevation model, since gradient records in the streams data layer were incomplete and did not provide information for much of the private and Forest Service land in the watershed (Appendix G). Stream gradient, channel confinement, and stream survey habitat data were used to determine stream reaches that are likely critical production areas, termed "hotspots," for salmonid production.

- Current stream reaches that can be considered critical salmonid production areas or hotspots are associated with the lower and middle, unconfined, depositional channel reaches and confluence areas with smaller tributaries directly entering the main (gradient from 0-3 percent) tributaries, such as Knowles, Sweet, Hadsall, Divide, Karnowsky, Lawson, Hoffman, Walker, and Barber Creeks. These streams and their tributaries contain 110 (73 percent) of the identified hotspots and some of the smaller tributaries. Hotspots, sometimes called "flats," are generally low-gradient, depositional stream reaches or areas that contain, under natural conditions, large amounts of LWD, high quality pools, the main channel connected to numerous off-channel areas, and suitable spawning and rearing areas for anadromous salmonids. Currently, most of the 151 identified hotspots, which vary in length from about a tenth of a mile to one mile, are located in stream reaches that are either non-functional or partially functional (Map 17). The only hotspots in functional stream reaches are found in upper Knowles (old-growth section), Waite, Brush, and Thompson Creek, middle Divide Creek, and Meadow Creek. Current potential hotspots are probably similar spatially to historic salmonid production areas. However, in most cases, current habitat quality has been severely degraded over time by a combination of stream cleaning, disconnection to floodplain, splash damming, adjacent road construction, mature riparian overstory removal, and livestock overgrazing.

- A model was developed intending to assess the current supply of LWD in the watershed (Map 18). By overlaying mature vegetative seral stages on the Berkeley Slope Stability Prognosis, the model revealed that about 1,739 acres in the watershed, consisting of stands of mature conifer, are located on slopes with a high risk of failure, and are within 150 feet of a stream (considered the zone of influence). These headwall source sites, whereby debris slides are likely to transport LWD down stream; are considered to exhibit a high LWD potential. The majority (9,932 acres) of potential LWD source areas occurs adjacent to streams within the zone of influence. These areas exhibit a moderate potential for providing in-stream LWD as compared to the headwall source sites, because trees in the zone of influence can fall away from the stream. An additional source site with a moderate potential for providing LWD occurs on unstable slopes outside of the zone of influence. These areas are not headawall, first order tributaries, but rather sites uphill that are rated by Berkeley as exhibiting a high risk of failure, and that have mature stands of conifer.

- Overall, approximately 9 percent of LWD source sites exhibit a high recruitment potential, 58 percent are rated as having a moderate potential, and 33 percent are rated as having a poor potential. Furthermore, there are road crossings in the watershed

that potentially restrict passage of LWD to streams (Map 18). Many of these sites occur on the major highways along the mainstem Siuslaw river and lower Knowles Creek. Most of the crossings that could be a barrier to LWD transport occur on arterial roads in the watershed. It is estimated that about 20 percent of the current available LWD supply (high recruitment potential rating), transported by slope processes or high water floatation, may be hindered at road crossings.

- Many of the steep (>20 percent gradient), confined source channels have been impacted by logging and road building. This has increased rates of landslides and decreased current and potential LWD loading (Map 18). Many of the moderately steep (4-20 percent gradients) and confined transport channels have also been impacted by logging and road building, causing increased road related debris torrents and increased sediment in these reaches.

- Also, many of the riparian zones have been logged, eliminating future potential input of LWD. Low gradient (<3 percent gradient), unconfined depositional channels (most sensitive to change, most altered, and most important to anadromous fish production) reflect cumulative effects of residential settlement, log drives, stream cleaning, roads, past removal of mature riparian overstory, and agriculture. The major impact was the elimination of in-channel LWD and disconnection with floodplain. Most of these channels in the Lower Siuslaw watershed are on private land, and stream channels and riparian areas continue to be impacted by overgrazing, roads, and logging activities.

- Since 1976, restoration of stream channels and riparian areas was accomplished using different methods. Early "misguided efforts" from 1976 to 1984 in Divide, Lawson and Hand Creeks concentrated on removing log jams and cleaning streams of LWD. In the 1990s, restoration efforts (Divide, Knowles and Hadsall Creeks) changed to installation of instream wood structures and riparian planting and thinning to promote faster growth of conifers.

- Stream shade adequacy in the riparian zone of influence was based on a model using channel confinement and current vegetation (Map 19; See Appendix C for methodology). Of the 372 miles of stream with the necessary components to determine the adequacy of shade (mostly federal land), 34 percent of the streams in the lower Siuslaw River watershed have older seral stage vegetation that provides near-natural shading, while the remaining streams contain either non-forest or very early seral stage deciduous and/or conifer mixed forest that does not provide natural shading conditions.

- Non-forest habitat (Map 19) includes riparian areas that have been converted from forested plant communities to grass/forb plant communities, primarily by agricultural activities. There are a few semi-open sites (as classified by CLAMS) along first and second order stream reaches on private land in Hadsall, Knowles, and eastern subwatersheds, that show up as non-forest habitat but actually are very young plantations. Non-forest habitat also includes estuarine grass/forb plant communities

that are tidally influenced by salt water, or grass/forb plant communities created by beaver ponds. Non-forest habitat displayed on the map is considered inadequate shade, and is likely the most susceptible to effects due to a lack of shade. The Cox Island (33 percent) and Divide (26 percent) sub-watersheds (not including the Florence and Berkshire sub-watersheds that contain the towns of Florence and Mapleton) have the highest percentages of non-forest riparian areas along the mainstem Siuslaw River, Duncan Inlet, and South Slough. Cedar (43 percent), Hoffman (68 percent), and Thompson (30 percent) sub-watersheds have the highest percentages of streams with adequate shading, while Upper Divide (63 percent) and Hand (61 percent) sub-watersheds have the highest percentages of riparian zones with inadequate shading.

4.5 VEGETATION PATTERNS

- The current vegetation in the Lower Siuslaw watershed is a heterogeneous mixture of patch sizes and seral stages. The lower reaches of the analysis area lie within the coastal fog belt, where the Sitka spruce (*Picea sitchensis*) plant series is prevalent. The uplands and eastern portions of the watershed are dominated by the western hemlock (*Tsuga heterophylla*) series. Common tree species throughout the watershed include Sitka spruce, western hemlock, western redcedar (*Thuja plicata*), Douglas-fir (*Pseudotsuga menziesii*), red alder (*Alnus rubra*), and bigleaf maple (*Acer macrophyllum*).

4.5.1 Plant Associations

- Plant associations in the watershed range from wet Sitka spruce environments to the drier western hemlock further inland. These associations describe the potential tree, shrub, and forb dominants that would be eventually expected to occupy an undisturbed site.

- As shown on Table 22 and Map 20, the watershed encompasses a range of plant associations, reflecting the variety of ecological conditions across the area. Most of the forested area (82 percent) is dominated by western hemlock series, with the remainder (18 percent) classed in the Sitka spruce series. The two dominant plant associations account for 72 percent of the analysis area. The western hemlock/sword fern association (TSHE/POMU) was mapped on 40 percent of the area. This plant association is most representative of moist sub-series environments. The western hemlock/salmonberry association (TSHE/RUSP), which is found mostly in wet sub-series environments, was found on 32 percent of the watershed.

Table 22. Acreage and Percent of Plant Association Groups by Subwatershed

Subwatershed	TSHE/RHMA	TSHE/GASH	TSHE/POMU	TSHE/RUSP	PISI/GASH	PISI/POMU	PISI/RUSP	Grand Total
	Acres							
Barber	71	138	2,277	570				3,056
Berksh	40	158	1,283	2,344				3,825
Cedar2	370	211	2,112	1,878				4,571
Coxisl			0		3	157	1,489	1,649
Divide	16	8	2,162	4,392	18	816	1,326	8,738
Floren			1		744	450	10,245	11,439
Hadsal	178	126	2,004	3,148				5,457
Hand	1,635	689	3,745	1,599				7,668
Hoffma	24	9	531	1,850		145	155	2,715
Hood	139	56	1,057	951				2,203
Knowle	64	118	1,818	1,605				3,605
Lawson	25	2	410	2,539		323	658	3,956
Lsweet	78	23	991	2,619				3,711
Meadow	39	792	3,911	695				5,437
Sanant	17	1,873	1,403	189				3,483
Siboco			42	78	325	1,338	2,349	4,133
Thomps	132	407	4,549	2,455				7,543
Tilden	127	1,241	3,758	1,582				6,707
Turner	115	103	2,182	1,472				3,873
Updiv	1	13	2,159	442				2,614
Upknow	688	288	3,399	2,245				6,620
Waite	61	496	2,080	1,056				3,693
Walker	37	313	2,878	1,557				4,785
Grand Total	**3,857**	**7,063**	**44,755**	**35,266**	**1,090**	**3,228**	**16,223**	**111,481**
% by PAG	**3%**	**6%**	**40%**	**32%**	**1%**	**3%**	**15%**	**100%**
% by Series	**82%**				**18%**			

Code	Scientific Name	Common Name
TSHE/RHMA	*Tsuga heterophylla/Rhododendron macrophyllum*	western hemlock/Pacific rhododendron
TSHE/GASH	*Tsuga heterophylla/Gaultheria shallon*	western hemlock/salal
TSHE/POMU	*Tsuga heterophylla/Polystichum munitum*	western hemlock/western swordfern
TSHE/RUSP	*Tsuga heterophylla/Rubus spectabilis*	western hemlock/salmonberry
PISI/GASH	*Picea sitchensis/Gaultheria shallon*	Sitka spruce/salal
PISI/POMU	*Picea sitchensis/Polystichum munitum*	Sitka spruce/western swordfern
PISI/RUSP	*Picea sitchensis/Rubus spectabilis*	Sitka spruce/salmonberry

4.5.2 Natural Disturbance Processes

- Natural disturbances have affected the vegetation patterns in the watershed for thousands of years. Fire, wind, insects, and diseases have influenced the structure, composition, pattern, size, and distribution of forest stands and habitats across the landscape. Fire and wind are the dominant natural disturbance processes. Historically, they affected the large scale vegetation pattern, and influenced the composition and structure of stands and landscapes.

Fire

- Historic records show that wildfire was the most prevalent disturbance factor in the watershed. Characteristically, fires in the Oregon Coast Range occurred infrequently, with more than two hundred years between major burns. These fires were characterized by high severity regimes (Agee, 1991).

- Reconstructive studies of past fire occurrence in the Oregon Coast Range showed that extremely large-scale fires burned across entire watersheds (Teensma et. al, 1991). Historically, many of these fires were human caused, both by American Indian and Euro-American settlers. This area has a very low incidence of lightning, and consequently, very few lightning-caused fires.

- The maps developed from Teensma et al. analysis show a huge burn area that extends far outside the analysis area (Maps 4 to 7). This fire or series of fires apparently originated around 1850. The progression of vegetative development is shown for 1850, 1890, 1920, and 1940.

- The apparent size of these wildfires can be misleading. The effects of topography and weather, as well as fuel condition and arrangement, affected fire behavior. For example, it has been observed that fires tended to have been more severe outside the coastal fog belt in the Sitka spruce zone (Franklin and Dyrness, 1973). Because of the many factors affecting fire behavior, the pattern of vegetation across the landscape after fire was complex, with numerous unburned patches forming an intricate and diverse mosaic. It is likely that draws, north and east aspects, and stream bottoms often escaped the conflagrations or burned lightly.

- Different burn intensities probably resulted in selective restocking of different tree species and affected the composition and structure of other vegetation. Remnant trees, patches, and stands that survived the burn would have characterized the forests that developed after these large and variable fires. Residual vegetation after major natural disturbance has added important complexity to forest habitats.

Wind

- Wind has been a dominant process affecting the development of vegetation patterns in the Oregon Coast Range, especially within the fog zone near the coast (USDA, 1997). This area is well defined by the Sitka spruce vegetation zone.

- Disturbance from wind has operated at two scales. Winter storm winds occur every year, and blowdown at the patch or stand level (small to medium scale) is not uncommon. Less frequent storms of extreme intensity, such as the 1962 Columbus Day storm, operate at the landscape level. Storms of this force occur perhaps only once or twice in a century, but when they do, they can alter and shape entire landscapes.

- The effects of wind on vegetation are a result of several factors, including storm intensity and direction, topography, and vegetative characteristics. The structure and composition of the forest has direct bearing on susceptibility to windthrow. For example, if the landscape is predominantly forested with young trees, it may be relatively resistant to windthrow. Conversely, exposed edges of mature forests are highly vulnerable. A study of the effects of hurricane-force winds on forested landscapes in central New England showed that the major factors influencing wind damage were stand height and forest type. Additional factors included physiographic (topographic) position and soil type (Fetherston, 1987).

- Specific locations of windthrow events and analysis of their effects were not identified for this report.

Insects

- Insect outbreaks can alter the landscape in significant ways. The historic role of insects in the Lower Siuslaw watershed is unknown, but epidemic populations could have affected stand structure and composition in the past. Most of the potential for insect damage is in mature or late seral stands, where outbreaks of the Douglas-fir beetle (*Dendroctonus pseudotsugae*) can develop after extensive windthrow or large fires. This bark beetle has the potential to kill trees over broad areas if broods are allowed to develop in dead or weakened trees (Furniss and Carolin, 1977).

- Past outbreaks of the western hemlock looper (*Lambdina fiscellaria lugubrosa*) in stands of western hemlock have been documented in the general area (Furniss and Carolin, 1977). Current insect disturbances in the watershed are minimal.

Diseases

- Native tree diseases are natural parts of the vegetative environment. Compared with other disturbances, they usually operate at a background level, often not apparent to casual observation. Yet the cumulative impact of tree diseases in shaping and forming stands and landscapes can be greater than other natural factors.

- Laminated root rot, caused by the fungus *Phellinus weirii*, has been noted as the most commonly encountered and damaging forest disease disturbance agent in the analysis area. Douglas-fir is highly susceptible to the disease. It is suspected that suppression of natural fire and the broad-scale planting of stands dominated by Douglas-fir may have contributed to spread and intensification of the disease, compared with historic levels.

- Swiss needle cast, a native foliage disease caused by the fungus *Phaeocryptopus gaeumannii*, has been a source of increasing concern in the management of young stands of Douglas-fir in the Oregon Coast Range. Several factors are suspected as causes of increased levels of the disease (Oregon Department of Forestry, 1996):

  Stand location. Southerly aspects appear to be more vulnerable. Locations near or within the coastal fog belt are highly susceptible.

  Stand age. The disease is more apparent in young plantations, although it occurs in mature stands as well.

  Genetics. It is thought that some of the Douglas-fir seed sources are not well-adapted to the coastal environment. Very local seed sources appear to have fewer problems from the disease.

  Climate and Weather. There may have been recent changes in climate and weather, with increases in humidity favoring the disease.

  Increase in Douglas-fir. A dramatic increase in the amount of Douglas-fir in young plantations has increased the amount of susceptible host as well as the amount of disease innoculum.

- Currently, Douglas-fir in this part of the Oregon Coast Range is not as heavily affected as areas further north. Ongoing detection surveys by the Oregon Department of Forestry and the USFSare monitoring the progress of the disease.

4.5.3 Stand Structure and Seral Stages

- Douglas-fir plantations typify the current vegetation (Map 21) in much of the watershed on both public and private lands. Over 40 percent of these forested areas is beginning to mature, with stand diameters approaching 20 inches (Table 23).

Table 23. Seral Stages (in acres) of Forest Types by Subwatershed Showing Areas in Stem Exclusion Phase

Sub-watershed	MATURE CONIFER	MATCONF MIX	MAT 50-80	PURE HARDWOOD	DECIDUOUS MIX	YOUNG CONIFER	YOUNG CONF MIX	CONF MIX POLE	EARLY POLE	VERY EARLY	TOTAL STEM EXCLUSION (acres)	PERCENT OF SUBWATERSHED IN STEM EXCLUSION
Barber	550	839	118	75	880	37	62	28	64		318	12
Berkshire	541	405	461	153	832	271	210	118	194	112	856	30
Cedar	*838*	*609*	187	*200*	*300*	1636	1017	575	388	*14*	*2543*	*56*
Cox Island	17	231	2	0	320	181	165	38	19		274	33
Divide	*1471*	*1190*	881	*486*	*1289*	335	613	359	490	*102*	*2178*	*32*
Florence	5	1133	101	10	441	103	265	163	46		859	35
Hadsall	513	916	60	328	1889	100	395	89	122	62	766	17
Hand	*2251*	*724*	305	*1091*	*391*	570	392	165	363	*307*	*2747*	*37*
Hoffman	*760*	*568*	376	*53*	*409*	261	102		210	*34*	*891*	*33*
Hood	33	552	32	1	805	42	205	42	2		323	19
Knowles	798	1162	65	68	397	162	188	183	6		492	17
Lawson	*776*	*1108*	87	*381*	*648*	216	33	16	325	*68*	*615*	*17*
Lower Sweet	*868*	*474*	30	*574*	*518*	4	237	19	367	*10*	*899*	*27*
Meadow	973	790	427		1137	705	665	291	218		2205	43
San Antone	228	252	91		533	1931	196	116	309	57	2243	68
Siboco	802	807	45	210	536	1141	164	305	721		1379	37
Thompson	*2219*	*1067*	176	*443*	*793*	566	561	246	549	*246*	*2200*	*32*
Tilden	1293	1132	102	148	1554	316	1414	423	212		2268	35
Turner	246	474	927	8	1714	246	361	92	76	1	877	26
Upper Divide	*1269*	*123*	17	*2*	*134*	364	30	8	163	*454*	*569*	*22*
Upper Knowles	*1956*	*405*	325	*339*	*1573*	30	289	57	368	*526*	*1290*	*21*
Waite	712	690	290	54	589	244	462	395	125	1	1140	36
Walker	*1828*	*503*	288	*108*	*367*	452	523	223	392	*130*	*1486*	*34*
Total	20948	16155	8555	4732	18047	7778	7192	3917	6575	2122	29419	32
% of Watershed Total	23	18	4	5	20	9	8	4	8	2		33

Key: Shaded cells represent stem exclusion stage, italicized print is predominantly Federal ownership.

Mature Conifer = Greater than 18" DBH conifer (conifer >70% cover)
Mat 50- 80 = Conifer 50 to 80 years old
Deciduous Mix = Any sized mixed hardwood, composition >70% cover
Young Conf Mix = 10-18" DBH conifer/hardwood (conifer >70% cover)
Early Pole = 5-10" DBH conifer, 11-24 yr old

Matconf Mix = Greater than 18" DBH conifer/hardwood
Pure Hardwood = Any sized dominantly hardwood composition >70% cover
Young Conifer = 10-18" DBH conifer dominant (>70% cover)
Conf Mix Pole = 5-10" DBH
Very Early = natural 0-5" DBH or <10 yr old plantation

- CLAMS data derived from satellite imagery were used to develop seral stage and structural information on state and private lands. Many of the young plantations in these areas were classed as hardwoods ("Deciduous Mix" and "Pure Hardwood") because of the large amount of young bigleaf maples present at the time the images were captured 12 years ago. Today, most of these plantations are well stocked with young conifers. This could mean that approximately 15,000 acres are in the early pole structural stage on state and private lands. The area in the stem-exlusion stage is likely to increase in the near term, as young plantations grow denser and the trees begin to compete with one another.

- There are virtually no stands in the watershed meeting the scientific definition of "old growth." However, the stands classed as "Mature Conifer" and "Mature Conifer Mix" were established following the wildfires in the 1800s. These stands are now 130 to 150 years of age, and generally meet the criteria for late-successional vegetation. In addition, there are remnant pockets of very old trees that survived past disturbances. Generally, these trees are found as small groups or scattered individuals within the "Mature Conifer" and "Mature Conifer Mix" structural classes.

- The vegetative pattern today is characterized by 20-80 acre harvest units that present a complex pattern across the landscape. Within these units, stands are relatively uniform, even-aged, and dominated by a single species, usually Douglas-fir. Current patch sizes have been reduced from the reference conditions in the mid-1900s (USDA, 1997). As a result of reduced patch size, the number of stands (or patches) has increased markedly from reference conditions.

4.5.4 Stand Dynamics

- As plantations grow, they tend to develop predictable structures at different points in time. Oliver and Larson (1990) described four characteristic stand structures that are useful in describing vegetative characteristics of the watershed (Table 24).

Table 24. Comparison of Seral Stages with Plantation Age Classifications

Seral Stage - Oliver and Larson	Forest Service Plantation Age Classifications	Description/ Definition
Stand initiation stage	0-20 years	After a disturbance, new individuals and species continue to appear for several years.
Stem exclusion stage	20-80 years	After several years, new individuals do not appear and some of the existing ones die. The surviving ones grow larger and express differences in height and diameter; first one species and then another may appear to dominate the stand.
Understory reinitiation stage	80-200 years	Later, forest floor herbs and shrubs and advance regeneration again appear and survive in the understory, although they grow very little.

Source: Oliver and Larson, 1990.

- The ages at which plantations reach a structural stage will vary by site growth capability as well as stand stocking. The data in Table 23 assume that the plantations are mid-site 2 (King, 1966) and that no stocking level control was done since plantation establishment. In point of fact, many of the young plantations in the analysis area have been pre-commercially thinned and some have been commercially thinned. Therefore, the data evaluated in this discussion somewhat overstates the present condition. Although stand records would indicate the extent to which thinning has taken place, this was not analyzed for this report.

- About one-third (32 percent) of the analysis area is in vegetation classes that could potentially be in the stem-exclusion stage of development (Table 23). Some of the stands classed as stem-exlusion could be in other structural stages as a result of stand history and site capability.

- For example, wet environments, such as salmonberry-dominated sites on cooler aspects, are more likely to establish at low densities, and could grow for extended periods before overstocking would occur. Likewise, stands that have been thinned and are growing at rapid rates, with minimal tree-to-tree competition, would not currently be in the stem-exlusion stage. The stem-exlusion stage appears to be fairly well distributed between major landowners, ranging from 26 percent on BLM lands to 33 percent on state and private lands (Table 25).

Table 25. Seral Stage by Ownership, Lower Siuslaw Watershed.

	BLM		SNF		State & Private		Total	
Seral Stage	acres	% of Owner	Acres	% of Owner	acres	% of Owner	acres	% of Owner
Mature Conifer	2723	60	15959	38	2266	5	20948	23
Matconf Mix	213	5	6443	15	9499	21	16155	18
Mat50-80	208	5	[illegible]	3	1889	4	3556	4
Deciduous Mix	15	0	2872	7	15160	34	18047	20
Pure Hardwood	322	7	1814	4	2596	6	4732	5
Young Conf Mix	54	1	1836	4	5301	12	7192	8
Young Conifer	667	15	4259	10	2792	7	7718	8
Early Pole	297	7	5263	12	1415	3	6975	8
Conf Mix Pole	5	0	949	2	2965	7	3919	4
Very Early	77	2	1543	4	501	1	2122	2
Total in Stem Exclusion	1169	26	13767	32	14483	33	29419	32
Grand Total	4519	100	42398	100	44505	100	91422	100

Shaded cells denote acres in stem exclusion stage.

- Resource scientists and land managers have recognized "the ecological crunch that competition among trees in closed-canopy forests exerts on an ecosystem..." (Carey and Curtis, 1996). Such stands often tend to stagnate or retard diameter growth as a result of competition between trees. As a result of competition, the tree crown

recedes, root areas are restricted, and weaker trees die out. Trees that are subject to increased competition become vulnerable to windthrow and breakage if they are thinned or if the stand is exposed to storms. There is often a "window of opportunity" in stand development, where intermediate treatments are feasible. If treatments are done later, the stand can incur excessive damage or mortality. Stands in the stem exclusion stage also shade out other vegetation, including shrubs and forbs. The result is often a condition that provides quality habitats for few organisms.

- Some subwatersheds have much larger proportions of their area in the stem exclusion stage of stand development than others (Table 23). For example, in the Florence, Cedar-2, Hoffman, Knowles, Sanant, Siboco, Waite, and Walker subwatersheds, more than 80 percent of the forest area is now in the stem exclusion stage. Three of these subwatersheds (Hoffman, Cedar-2, and Walker) are predominantly in federal ownership, as shown in Map 2. Because of this consolidated land ownership, these areas have the greatest capability for restoration activities that could accelerate development of desired structural characteristics.

4.6 TERRESTRIAL WILDLIFE SPECIES AND HABITATS

- Prior to European settlement, the watershed was dominated by large interconnected blocks of mature and older conifer trees. Frequent small scale disturbance combined with infrequent larger scale disturbance created forest habitats within the watershed that were probably very complex with gradual gradation from one habitat type to the next (USDA and BLM, 1997). The complex landscape provided habitat for a wide diversity of wildlife.

- Following European settlement, land management practices and land ownership patterns created sharp habitat boundaries with conspicuous contrast between adjacent habitats. These forest management practices resulted in fragmentation and changes in the dominance and distribution of habitat type and are believed to have altered species composition within the watershed, favoring edge species, early to mid-successional species, and habitat generalists while reducing the number of late-successional dependent species.

- The Lower Siuslaw watershed supports a diversity of wildlife habitat and species. This analysis does not attempt to cover all species known or expected to occur in the watershed. It focuses on threatened and endangered, survey and manage, and selected Forest Service sensitive species associated with conifer forest. Recreationally-important species such as Roosevelt elk, cougar, and black bear also are addressed.

4.6.1 Mature Forest Habitat and Associated Species

Mature/Late Successional Habitat

- Late successional forest is described as forest seral stages that contain the mature and old growth age classes (USDA and USDI, 1994). Mature age class for conifer stands in western Oregon is generally defined as 80-200 years of age (FEMAT 1993; USDA/ and USDI, 1994). The term old-growth as used here indicates stands that are greater than 200 years old with large conifer trees (Franklin and Spies, 1991). Old-growth forests generally exhibit high structural heterogeneity, including a multi-storied canopy comprised of a wide range of tree diameters and height, the presence of tall, large diameter trees, and abundant snags and down logs (Franklin and Spies, 1991).

- In the preparation of this watershed analysis GIS limitations prevent discrimination between mature and old-growth forest stands. As a result, mature (mature and old-growth stand types) is used here to represent conifer and mixed conifer stands 80-200 years old and/or with an average stand greater than 8 inches diameter at breast height (dbh).

- **Reference Conditions:** Historically late successional forests were distributed in large patches across the watershed on a mosaic of small to large sized openings created by wind, disease, and/or fire. Large size openings were primarily due to stand replacement fire, and occurred on a frequency of approximately 200 years or more (USDA and BLM, 1997). Historic vegetation maps (Maps 4 to 7) show examples of typical distribution of late successional forests following large scale stand replacement fires. Fires burned large portions of the watershed, but the unaffected areas remained as interconnected late-successional forest. The coarse scale of these maps does not show the small patches of forest that remained relatively unaffected within the fire boundaries. In addition, biological legacy material (large green trees, snags, and coarse woody debris) was most likely common within disturbance areas and aided in restoration of late successional characteristics.

- **Current Conditions:** Disturbance regimes over the last 200 years have resulted in older forest conditions (where present) that are primarily in the mature seral class with vegetation age ranging from 75-150 years of age (USDA and BLM, 1997). Timber harvest and land clearing for agriculture have been the dominant and persistent form of disturbance, although fire heavily influenced the amount of old-growth. Currently there are approximately 25,338 acres of mature forest habitat under federal jurisdiction within the watershed and 21,031 of these acres are in the LSR's (Map 22). Based on historic harvest practices it is expected that biological legacy material is rare in all but the oldest stands. Table 26 shows current seral conditions by ownership. Table 27 shows seral conditions by subwatershed.

Table 26. Current Seral Conditions by Ownership

	OWNERSHIP							
	BLM		SNF		State and Private		Grand Total	
	Acres	% of Ownership	Acres	% of Ownership	Acres	% of Ownership	Acres	% of Total Acres
Mature Conifer	2,723	60%	15,959	37%	2,266	4%	20,948	19%
Matconf Mix	213	5%	6,443	15%	9,499	15%	16,155	14%
Deciduous Mix	15	0%	2,872	7%	15,160	24%	18,047	16%
Pure Hardwood	322	7%	1,814	4%	2,596	4%	4,732	4%
Mat 50-80	208	5%	1,460	3%	1,889	3%	3,556	3%
Young Confmix	54	1%	1,836	4%	5,301	8%	7,192	6%
Young Conifer	607	13%	4,259	10%	2,912	5%	7,778	7%
Early Pole	297	7%	5,263	12%	1,415	2%	6,975	6%
Confmix Pole	3	0%	949	2%	2,965	5%	3,917	4%
Very Early	77	2%	1,543	4%	501	1%	2,122	2%
Grass/Forb	34	1%	281	1%	3,077	5%	3,392	3%
Semi-Open	3	0%	95	0%	12,072	19%	12,170	11%
Water		0%	10	0%	1,443	2%	1,453	1%
Open		0%	177	0%	2,702	4%	2,880	3%
Shadow	0	0%		0%	98	0%	99	0%
Cloud		0%		0%	0	0%	0	0%
Untyped	2	0%	1	0%	17	0%	20	0%
(blank)	4	0%	26	0%	15	0%	45	0%
Grand Total	**4,563**	100%	**42,989**	100%	**63,930**	100%	**111,481**	100%

Table 27. Seral Stage by Subwatershed

Sub-watershed	Mature Conifer	Matconf Mix	Mat 50-80	Pure Hardwood	Deciduous Mix	Young Conifer	Young Confmix	Confmix Pole	Early Pole	Very Early	Semi-Open	Open	Grass/ Forb	Water	Shadow	Untyped	(blank)
BARBER	550	839	118	75	880	47	62	28	64		344	38	12				
BERKSH	541	405	61	153	832	271	212	118	194	112	517	169	206	34	0	0	
CEDAR2	838	609	127	200	300	1,336	117	375	588	14	18	0	47			0	2
COXISL	17	231	2	0	320	61	155	38	19		271	36	472	2	24	1	0
DIVIDE	1,471	1,190	381	486	1,289	335	613	359	490	102	758	221	969	69	1	1	2
FLOREN	5	1,133	101	10	441	194	365	153	46		6,192	1,096	337	1,293	69	1	2
HADSAL	513	916	60	328	1,886	100	395	89	122	62	587	387		0		8	4
HAND	2,251	724	306	1,091	391	520	392	162	1,368	307	37	18	91			1	9
HOFFMA	760	568	315	53	409	254	112		210	34	0					0	
HOOD	33	552	32	1	805	42	205	42	2		235	253			0		
KNOWLE	798	1,162	54	68	397	62	188	183	6		418	154	117	0			
LAWSON	776	1,108	87	381	648	216	33	6	273	68			357				3
LSWEET	868	474	80	574	518	4	237	14	564	10	88	3	276			0	
MEADOW	973	790	427		1,137	705	565	291	218		235	63	31			0	2
SANANT	228	252	91		533	931	196	715	309	57	141	27			0	2	2
SIBOCO	802	807	46	210	536	141	164	305	724		134	80	172	10	1	1	1
THOMPS	2,219	1,067	176	443	793	668	561	246	549	246	341	48	162	21	0	1	2
TILDEN	1,293	1,132	102	148	1,554	316	1,214	423	212		234	38	38		1	1	0
TURNER	246	474	92	8	1,714	256	361	92	76	1	513	37	3				
UPDIV	1,269	123	14	2	134	364	50	8	133	454	53	9				0	2
UPKNOW	1,956	405	528	339	1,573	59	289	51	363	526	450	68			0	3	11
WAITE	712	690	90	54	589	444	382	99	125	1	419	85		0	1	0	1
WALKER	1,828	503	266	108	367	452	323	123	322	130	184	50	102	24	0		1
Grand Total	20,948	16,155	3,556	4,732	18,047	7,778	7,192	3,917	6,975	2,122	12,170	2,880	3,392	1,453	99	20	45

SERAL STAGE	DESCRIPTION
Mature Conifer	> 18"dbh conifer
Matconf Mix	> 18"dbh conifer/hardwood
Mat 50-80	Conifer 50-80 years old
Pure Hardwood	Any sized dominant hardwood dominant (>70% cover)
Deciduous Mix	Any sized mixed hardwood dominant (>70% cover)
Young Conifer	10-18"dbh conifer dominant (>70% cover)
Young Confmix	10-18"dbh conifer/hardwood (>70% cover)
Confmix Pole	5-10"dbh
Early Pole	Conifer, 5-10"dbh, 11-24 years old
Very Early	Natural 0-5"dbh or <10 year old plantation

Snags

- **Reference Conditions:** Snags are an integral component of late successional/old growth systems and provide important structure in developing stands. Based on historic vegetation maps and disturbance regimes, fire, disease, wind damage and natural mortality, most likely provided snags in multiple age and size classes across the watershed.

- **Current Conditions:** There is no information on the current density of snags within the watershed. However, much of the forested lands within the watershed have been harvested and are in the second or third rotation. Most of the managed stands were subject to regeneration cuts and few have retained snags or green trees to provide future snag recruitment. Recent (past two decades) harvest on federal lands has retained some snags or recruitment material, while private land management has left almost none. Generally, it may be assumed that large diameter snags are scarce throughout the watershed. Most existing snags may be expected to occur in unmanaged mature stands and in riparian areas.

Coarse Woody Debris

- **Reference Conditions:** Coarse woody debris (CWD), like snags, is an important component of forested systems. CWD provides habitat for a wide variety of wildlife and provides important physical structure to streams as well as a growth medium for many species of vegetation (Bartels et al., 1985). No information is available on current or historic CWD amount, size, or decay class distribution. Like snags, CWD is created through disturbance or natural mortality. Historically CWD was probably scattered across the watershed, but concentrated in areas susceptible to wind, landslide or disease. Large-scale stand replacement fires provided inputs of CWD across larger portions of the watershed.

- **Current Conditions:** CWD in large size classes is probably lacking from the majority of stands within the watershed. Past harvest practices called for yarding all cull logs above a certain diameter and length to a deck to open the harvest unit for replanting. The decks were sold as firewood or burned. Broadcast burning of harvest units further reduced CWD. Most CWD available today is probably created by wind and landslide and is in early decay classes. Large diameter CWD in the later decay classes are most likely lacking in most areas and limited to unmanaged mature stands.

Fragmentation

- **Reference Conditions:** Historically mature forests were distributed in large patches across the watershed with small to large sized openings in the canopy created by wind, landslide, disease, and/or fire. Large sized openings occurred infrequently and were predominantly the result of stand replacement fires. It is expected that small to medium sized opening created by disease, landslide or wind occurred more

frequently. Seasonal flooding of the Siuslaw River created fluctuating water table levels that affected plant communities resulting in open meadows/wetlands, scrub/shrub and deciduous areas along both banks.

- **Current Conditions:** Mature habitat in the watershed is dominated by small patches distributed throughout a matrix of recent harvest units and early to mid seral stage regeneration (average patch size =102 acres; median = 3; range less than 1 to 5,196 acres). Mature habitat on federal land occurs in larger patches with average patch size of 135 acres (median = 15; range less than 1 - 2,240 acres). The Siuslaw River, Highway 36, and private land bisect the watershed in a variable-width band from east to west. The "band" is wider in the eastern portion of the watershed south of the Siuslaw, and at the extreme western edge of the watershed where the City of Florence and Highway 101 cross the watershed from north to south. The Sweet Creek valley bottom is primarily privately owned from its mouth to the headwaters. This relatively thin band divides the southern LSR on a north south axis. The majority of the private lands within the watershed, outside the City of Florence, are managed for timber production on short rotations or have been cleared for agriculture. This east-west division increases the distance between late successional patches on a north-south axis.

4.6.2 Interior Mature Forest Habitat

- An increase in the amount of mature forest habitat influenced by edge is one of the major effects of fragmentation. Microclimate change along patch edges alters the conditions of interior plant and animal species (Lehmkuhl and Ruggiero, 1991), and reduce the amount of interior old-growth habitat. Along these edges, the habitat usually becomes drier and receives more light, increasing the abundance and vigor of early seral vegetation and the probability of their establishment in patch interiors (Lehmkuhl and Ruggiero, 1991). Experiments in Pacific Northwest forests by Lehmkuhl and Ruggiero (1991) suggest that microclimatic effects extend up to approximately 500 feet from the patch edge. Based on these estimates, patches of old-growth, 25 acres or smaller, effectively are all edge and have lost the essential attributes of the old-growth condition (Lehmkuhl and Ruggiero, 1991).

- **Reference Conditions:** The large patch size that historically occurred within the watershed typically resulted in large amounts of contiguous mature interior habitat and a low edge to interior habitat ratio. The amount and distribution of the interior habitat varied temporally and spatially throughout the watershed.

- **Current Conditions:** Interior forest habitat is limited in the Lower Siuslaw watershed (Map 23). There are approximately 7,733 acres of interior forest habitat consisting of stands greater than 80 years old within the watershed. The amount of interior habitat was determined using a 500-foot buffer, irregardless of the seral stage of the adjacent stand; therefore, this number should be considered conservative. The actual extent of edge effect is determined by the slope position and aspect of the interior stand, and by height, density, and species composition of adjacent stands.

Interior habitat is concentrated in Thompson and Walker subwatersheds (27 percent), Tilden Barber, Knowles subwatersheds (21 percent) and upper Knowles subwatershed (10 percent).

4.6.3 Riparian Habitat

- Riparian Reserves were established on federal land by the Northwest Forest Plan (1994) to place primary emphasis on maintaining the ecological and physical process of the ecotonal areas between water bodies and uplands (the riparian area). The riparian area provides special microclimate conditions necessary for, or conducive to, survival of many plant, fish, and wildlife species (Brown 1985). The administrative boundary of Riparian Reserves may be substantially different from the indistinct boundary of the riparian area. Riparian Reserves were established not only to benefit aquatic and riparian dependent species and their habitat, but also to provide connections between habitat patches and across drainages, thus facilitating dispersal and migration of species dependent on late-successional habitat characteristics. Breaks of great distance or excessive narrowing of the Riparian Reserve can reduce or eliminate its ability to provide these functions.

- **Reference Conditions:** Historically, vegetation types and canopy closure within the riparian area varied according to stream size, channel form and slope, valley shape, and flood frequency. Typically, fire effects were greatly reduced in the riparian area, and the major disturbances were floods and landslides, resulting in a system dominated by large, old trees and large amounts of coarse woody debris. As a result of stream action, the faster-growing deciduous trees occurred in stringers of variable width immediately adjacent to the water body. The amount of area within approximately 200 feet of the water body dominated by deciduous species depended on stream gradient. Steep (source and transportation) reaches had low amounts of deciduous species (10 to 25 percent), 25-50 percent of the area within 200 feet of the flatter (depositional) reaches was deciduous dominated (USFS and BLM 1997). The wide flood plains, beaver ponds, and open wet meadows common in the flatter reaches affected ground water levels, resulting in the higher proportion of more tolerant deciduous species.

- **Current Conditions:** Land management activity (timber harvest and agriculture) has altered the species and age composition of riparian areas. Because the boundaries of the riparian area are indistinct and depend on many features, no attempt to quantify the amount of vegetation by seral stage or type was made; however, seral stages present within Riparian Reserves provide a useful assessment of riparian vegetation conditions. Riparian Reserves on federal land consist of 21,876 acres, of which 30 percent are mature conifer/conifer mix. Many areas formerly dominated by conifers have been converted to hardwood-dominated stands, young to mid seral stage conifer plantations, or meadows/fields (almost exclusive to private land). Log drives, stream cleaning, and timber harvest have reduced the number and size of down logs within streams and the riparian areas. The effects of timber harvest and agriculture are substantially more pronounced on private land. Map 24 shows the seral stages within

the adminstrative Riparian Reserve boundaries on federal lands. Generally, all riparian areas on private lands are now dominated by deciduous stands or herbaceous species. Some of the conversions in vegetation, such as in Sweet Creek and portions of Knowles Creek, may act as a barrier to movement of terrestrial species, or subject them to increased predation.

4.6.4 Centers of Biodiversity

- Centers of biodiversity, or biodiversity hotspots, are considered to be old multi-storied conifer stands with a wide diversity of plant species. Due to the natural disturbance regime of the watershed and the extensive harvest activity that has occurred, stands with these characteristics are rare within the watershed and have small patch sizes. These stands typically have a higher number of late seral plants compared to plantations or younger natural stands and have complex vertical and horizontal structure related to snags, CWD, and highly variable understory and canopy. They provide habitat for some vertebrate species that do poorly or do not occur in less complex habitat types. No available inventory information was available to locate these hotspots. CLAMS data did not show any old-growth.

- Current mapped mature and mature conifer mix stands were overlain on stands mapped as old-growth in the 1890 vegetation map. Where the two intersect are the most likely places to contain the features described above based on the premise that they are either still old-growth stands or they would have had to been disturbed prior to approximately 1915 to appear as mature (greater than 80 years old) on the current vegetation map (Map 21). Since no major disturbances are mapped between 1840 and 1920 and intensive logging did not begin until 1910 or later, this should provide a valid approximation of the amount and location of the oldest forest stands within the watershed. Potential biological hotspots are shown in Map 25.

4.6.5 Special Habitats

- Special habitats include cliffs, rock faces, talus, lakes, ponds, marshes and meadows and some human structures including buildings, mines, and certain types of bridges. The geology of the Lower Siuslaw did not produce many exposed rock features. Special habitats, however, associated with water are present throughout the watershed. Coastal lakes, bogs, and marshes occur in the most western part of the watershed and wetlands and ponds are found along stream corridors in the remaining areas. Beaver ponds, sloughs, and side channels are probably the most frequently occurring special habitat within the watershed. However, these features are typically transitory spatially and affected by natural events such as floods and natural succession. An ongoing study of bat use of bridges in the watershed found five bridges known or believed to have high potential for bat use in the Sweet Creek and Hadsal Creek drainages. Map 26 shows the location of known special habitats.

4.6.6 Current and Proposed Land Uses

Recreation

- Most recreational activities in the watershed occur in the ocean beach/dune areas or are related to hunting and fishing. Recreational use in the watershed is concentrated on the Siuslaw River and forest roads. The Siuslaw River is used by recreational anglers and boaters during most of the year. Roads are used to access hunting areas and for recreational drives. Trail use is limited to three miles of developed trail in the Sweet Creek and Beaver Creek drainages accessed from four trail heads. All trails are located within LSR boundaries. The Achie Knowles campground, the only developed campground within the watershed, is located within LSR boundaries, although there are undoubtedly numerous undeveloped, unmapped dispersed camping areas and regularly used hunting camps.

- A "Crest of the Coast Range" scenic driving route has been proposed that would follow existing roads on a north-south route through the watershed. Implementation of this driving route would result in increased vehicle traffic through the watershed.

Land Allocations

- Matrix land accounts for a small portion of the total watershed. Matrix land within the watershed is located in small isolated patches in the Tilden, Divide, Upper Divide and Siboco subwatersheds (Map 27; Table 23). Slightly larger patches of Matrix land is located in the Berkshire, Walker, and Thompson subwatersheds. Riparian reserves dissect most of the matrix lands. The number of acres of Riparian Reserve outside LSR boundaries is summarized in Table 2. The Matrix land in the Berkshire, Upper Divide and Walker subwatersheds bisects the LSR from north to south.

Special Use Grazing Permit

- Approximately 45 acres of federal land (designated as LSR) in the Karnowsky Creek drainage is grazed under a special use permit. Grazing is seasonal, and animals are moved off during the winter and return in the spring with timing determined by weather and vegetative condition. Karnowsky Creek is primarily vegetated with a deciduous mix. Whether this is a result of grazing, natural disturbance or previous land management activity is unknown.

4.6.7 Roads

- Current mapped road density within the watershed is 3.2 miles per square mile. Table 11 contains a complete breakdown of road miles and road density by subwatershed. Roads within LSR areas are primarily roads built to facilitate land management activities. These roads most likely receive relatively low use except those used as haul

routes for transporting forest products. The Northwest Forest Plan (1994) and the Siuslaw National Forest Plan (1990) contain no guidance regarding road density in LSR's or regarding to big-game management.

4.6.8 Late Successional Dependent Species

Northern spotted owl (*Strix occidentalis caurina*)

- **Reference Conditions:** Spotted owls probably were fairly abundant and well distributed throughout the watershed based on the amount and distribution of mature forests (Figures 1 to 4). Disturbance undoubtedly altered population numbers and distribution temporally and spatially, but natural successional development and colonization bydispersing birds generally provided replacement habitat and animals.

- **Current Conditions:** The amount of spotted owl habitat (mature conifer, mature conifer/mix) currently available on federal lands within the watershed is shown by subwatershed in Table 28. Approximately 57 percent (21,031 acres) of the suitable habitat is within LSR. A 1.5-mile-radius circle is used to determine the amount of suitable habitat around an owl site center. The amount of mature habitat required within the circle is 40 percent or 1,906 acres.

- There are 20 spotted owl activity centers including three known nest sites, and one territorial single (18 of the owl activity centers and all of the nest sites are on federal land). Thirteen of the 16 activity centers for which habitat data was available are currently below the suitable habitat threshold. The amount of mature habitat within the median home range of each owl activity center is shown in Appendix D.

Marbled Murrelet (*Brachyramphus marmoratus*)

- **Reference Conditions:** The watershed's close proximity to the ocean and historic vegetation conditions indicate that murrelets, like spotted owls, were probably abundant historically. Murrelets may nest in younger stands with structural defects such as mistletoe or stands that maintained some legacy trees following disturbance (Ralph et. al., 1995) such as those that were probably present following the large fires that occurred in the watershed.

- **Current Conditions:** All federal lands within the LSR's in the watershed (37,103 acres) have been designated as Critical Habitat for the murrelet (USDI, 1996). Suitable murrelet nesting habitat has been described as old-growth or mature conifer dominated stands with complex structure, high densities of large trees (22.5 trees per acre greater than 32 ininches dbh), large nesting platforms and hiding cover (USDI, 1991; Grenier and Nelson, 1995).

- The resolution available through GIS for determination of suitable habitat is not sufficient to define stands with these characteristics. Therefore, suitable habitat is defined as mature conifer/mature conifer mix for the purpose of this assessment. This

may lead to an over-estimation of actual suitable habitat. However, the majority of mature stands present in the watershed survived or were created by fire, indicating that they may contain older forest structures, and potentially making them suitable for nesting (Grenier and Nelson, 1995). Approximately 25,338 acres of federal land within the watershed provide potential suitable habitat. The amount of potentially suitable murrelet habitat on federal, state, and private land is shown in Table 28.

- There are all or portions of 36 known murrelet activity areas (areas of contiguous suitable habitat within 0.5 miles of an occupied site) within the watershed. Most activity centers are located in the central portion of the watershed, with slightly more (63 percent) centered on federal land. Table 28 shows the amount of suitable habitat within a 0.5-mile radius of each occupied site (Appendix D).

Table 28. Potentially Suitable Marbled Murrelet and Northern Spotted Owl Habitat by Subwatershed

SUBWATERSHED	SUITABLE HABITAT (Acres)	PERCENT OF SUBWATERSEHD
Barber	1,389	45
Berkshire	946	25
Cedar 2	1,447	32
Cox Island	248	15
Divide	2,661	30
Florence	1,138	10
Hadsal	1,429	26
Hand	2,975	39
Hoff	1,328	49
Hood	585	27
Knowles	1,960	54
Lawson	1,884	48
Meadow	1,763	32
San Antone	480	14
Sibco	1,609	39
Lower Sweet Creek	1,342	36
Thompson	3,286	44
Tilden	2,425	36
Turner	720	19
Upper Divide	1,392	53
Upper Knowles	2,361	36
Waite	1,402	38
Walker	2,331	49
Total	**39,434**	35

Bald Eagle (*Haliaeetus leucocephalus*)

- **Reference Conditions:** There is no historic information regarding bald eagles within the watershed. However, based on the historic vegetation pattern map (Figures 4 to 7), potential nesting and roosting habitat was abundant in the watershed. Disturbance affects varied the amount and distribution of suitable habitat both spatially and temporally. The number of anadromous salmonids present in the watershed combined with available waterfowl and shore birds in the lower reaches of the Siuslaw River provided a diversity of high-quality potential food resources.

- **Current Conditions:** There are two bald eagle management areas established around known nests on national forest lands along the Siuslaw River in the western portion of the watershed, and one on BLM land in the eastern portion of the watershed. No nest or regular use is known to occur within the BLM bald eagle management area. Approximately 1,815 acres (23 percent of the total management area) within the westernmost national forest management area is mature forest, and 172 acres (65 percent of the total management area) within the eastern national forest management area are mature forest. The westernmost management area is primarily private land. The eastern management area is entirely on federal land. Both known nests were active last year. The westernmost nest was first observed and determined to be active in 1973, and has produced 4 chicks in the 8 years it has been monitored. The easternmost nest was first observed in 1994, and has produced 4 chicks in the past 4 years.

- Potential suitable bald eagle habitat is generally fragmented and scattered throughout the watershed. The best habitat would be mature stands within 0.5 mile of the Siuslaw River. The best nesting habitat may be in the larger contiguous mature stands in the Walker, Tilden, and Waite subwatersheds on the south side of the Siuslaw River. All of these stands are located within 0.5 miles of the Siuslaw River. Foraging occurs on the Siuslaw River and major creeks within the watershed. Eagles may also forage in the lower estuary for fish, waterfowl, and shorebirds. The best foraging areas are probably in the lower watershed where all these forage sources are readily available. Declines in salmonid populations may be adversely affecting eagles using the watershed.

4.6.9 Threatened or Endangered Species, Candidate Species, and Species of Concern

- A list of federally endangered, threatened, and proposed species; candidate species; species of concern (SOC); survey and manage species; and game species known to occur or potentially occur in the watershed is shown in Table 29.

Table 29 Terrestrial Wildlife Species Addressed in the Lower Siuslaw Watershed Analysis

Species (Common Name)	Scientific Name	Status	Presence	Inventory
Northern spotted owl	*Strix occidentalis caurina*	Federal Threatened	Known to occur	4
Marbled murrelet	*Brachyramphus marmoratus*	Federal Threatened	Known to occur	4
Bald eagle	*Haliaeetus leucocephalus*	Federal Threatened	Known to occur	4
Pacific fisher	*Martes pennanti*	Federal Species of Concern	Unknown	N
Red tree vole	*Phenacomys longicaudus*	Survey and Manage	Suspected	N
Northwestern pond turtle	*Clemmys marmorata marmorata*	Federal Species of Concern		N
Southern torrent salamander	*Rhyacotriton variegatus*	No Status	Unknown	N
White-footed vole	*Phenacomys (Arborimus) albipes*	Federal Species of Concern	Suspected	N
Red-legged frog	*Rana aurora*	Federal Species of Concern	Known to occur	N
Tailed frog	*Ascaphus truei*	Federal Species of Concern	Known to occur	N
Bats (miscellaneous species)		Federal Species of Concern	Known to occur	2
Roosevelt elk	*Cervus elaphus Roosevelt*	Game	Known to occur	1
Black bear	*Ursus americanus altifrontalis*	Game	Known to occur	1
Mountain lion	*Felis concolor*	Game	Known to occur	1

Inventory:
N=No surveys done
1=Casual, unstructured surveys
2=Structured spot surveys
3=Structured surveys not to protocol
4=Surveys to protocol

Threatened or Endangered Species

- The northern spotted owl, marbled murrelet, and northern bald eagle were previously discussed. The other threatened or endangered species on the list are associated with habitats that are not found within the analysis area. Aleutian Canada geese (*Branta canadensis leucopareia*) typically are found on offshore islands or foraging in esturine grasslands. Brown pelican (*Pelecanus occidentalis*) occur at the mouth of the Siuslaw in the estuary. Peregrine falcons (*Falco peregrinus*) may occur in the lower estuary and forage on waterfowl and shore birds. There are no known suitable

nest sites for peregrines within the analysis area. However, they may occur on foraging flights or during migration. Snowy plover (*Charadrius alexandrinus nivosus*) are limited to the open dunes adjacent to the ocean.

Species of Concern

Pacific fisher (*Martes pennanti*)

- **Reference Conditions:** Pacific fisher historically occurred throughout the Coast Range although were never abundant (Marshall et. al., 1996). Trapping, predator control and harvest activity are believed to have resulted in substantial decline in numbers (Powell and Zielinski, 1994; Marshall et. al., 1996). Trapping for fisher was closed in 1937, but additional mortality from incidental trapping and baiting for predator control undoubtedly occurred following the closure (Marshall, et. al., 1996). The reduction of late-successional conifer forest and extensive fragmentation are believed to be the major impairment to recovery of fisher populations (Powell and Zielinski, 1994). No information on fisher use specific to the watershed was found.

- **Current Conditions:** No surveys for fisher are known to have been conducted in the watershed. Fisher do occur in the Siuslaw National Forest with a sighting reported in 1991 (USDA and BLM, 1996). However, no observations of fishers in the watershed have been reported. Pacific fisher are closely associated with mature and old-growth conifer (Douglas-fir) forests with high canopy closure, and are believed to actively avoid openings and open deciduous forests (Powell and Zielinski, 1994). The level of fragmentation and lack of late-successional conifer habitat limits the likelihood that fisher occur or would disperse into the watershed. The best potential habitat in the watershed is the large block of mature conifer in the Upknow subwatershed, and in the Tilden, Knowles and Barber subwatersheds.

White-footed vole (*Arborimus albipes*)

- **Reference Conditions:** The white-footed vole, a member of the Arvicolidae family, is considered the rarest microtine rodent in North America and as such, very little is known about its life history (Maser and Johnson, 1967). Maser and Johnson (1967) found that on the Oregon coast, white-footed voles were found exclusively in riparian alder/small stream habitat (Maser and Franklin, 1974). Old growth or mature forest also appear to be a requirement for the vole. Anthony et. al., (1987) only captured white-footed voles in areas where old growth conifers were present along the stream sides. Several authors also report finding them in thickets of salmonberry (*Rubus spectabilis*), under stream banks, or in debris piles immediately adjacent to streams. They are almost always found in very close proximity to streams, usually within 35 meters (115 feet) of the stream. (Maser and Hooven, 1969).

- **Current Conditions:** Riparian habitat dominated by hardwoods is common throughout the watershed, potentially providing extensive habitat for white-footed vole. However, the fragmented nature and general lack of late-successional conifer in

the riparian area may limit habitat suitability. No surveys for white-footed voles are known to have occurred in the watershed. The best potential habitat appears to be in federal lands in the center of the watershed (Map 24).

Bats

- Long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), Yuma myotis (*Myotis yumanensis*), and the Western Pacific big-eared bat (*Plecotus townsendii townsendii*)

- Bats are recognized as an important component of forest ecosystems. They are a main predator of nocturnally-active adult forms of many forest insect pests. No information was available on historic distribution and abundance of the above species. However, based on habitat requirements, these species were most likely relatively common. Generally, these species are all associated with late-successional forest (particularly the long-eared myotis which is known to roost almost exclusively in late successional stands), but may roost in several habitat types (caves, rock fields, large live and dead trees, and downed logs) with most foraging occurring over water (Maser, et al., 1981; FEMAT, 1993; Christy and West, 1993).

- Distribution of individual bats and bat species in forests is non-random and the primary factor appears to be roost limitation (Perkins and Cross, 1988). Loss of larger diameter live and dead trees has resulted in a reduction of natural roosting sites for bats. However, certain bridge types (Perlemeter, pers. comm., 1997; Adams, pers. comm., 1997) and various buildings throughout the watershed may provide additional roost sites. Whether these created roosts provide replacement habitat of similar quality and quantity is unknown. A survey to determine bat use of bridges found that four bridges within the watershed are known to be used by bats and a fifth has high potential (Adams, pers. comm., 1997). Little is known of the distribution and diversity of bat species in forests primarily managed for timber fiber such as are present on private forest land within the watershed.

Amphibians and Reptiles

- Two amphibian (northern red-legged frog [*Rana aurora aurora*] and southern torrent salamander [*Rhyacotriton variegatus*]) and one reptile (western pond turtle [*Clemmys marmorata marmorata*]) Species of Concern are known to occur in the watershed (J. Applegarth, pers. comm., 1997), and the tailed frog (*Ascaphus truei*) is suspected to occur. No information was available regrading historic distribution and abundance. At least one survey for amphibians and reptiles has been conducted on BLM lands in the central portion of the watershed. Data forms and field notes are in Appendix E (John Applegarth's data).

- Tailed frogs are generally associated with permanent, cold, fast-flowing streams in forested environments, particularly near headwaters with rocky substrate (Blaustein et. al., 1995; Leonard et. al., 1993), although stream size does not appear to be a

limiting factor, and they may be found in all sized streams. Adult tailed frogs may be found in uplands several hundred feet from streams (J. Applegarth, pers. comm., 1997). Juveniles may move from riffle-habitats to pools during the winter to avoid being displaced or injured by moving rock or debris carried by high water (J. Applegarth, pers. comm., 1997). Blaustein et. al. (1995) believed that of the frogs associated with late-successional forests, the tailed frog is most likely to be affected by degradation and removal of old-growth forests. Increased sedimentation and stream temperatures following canopy removal on streams may have affected tailed frog populations. Based on habitat requirements, tailed frogs were probably most common in the eastern and central portion of the watershed in areas where aspect and slope prevented substantial disturbance from fire events.

Survey and Manage Species

Red tree vole (*Phenacomys longicaudus*)

- **Reference Conditions:** Historical distribution and abundance of red tree vole in the watershed is unknown. However, based on known habitat requirements (conifer stands greater than100 years old (Carey and Johnson, 1995) it may be assumed that suitable habitat was historically in much of the watershed.

- **Current Conditions:** Past harvest activities substantially reduced the amount of red tree vole habitat within the watershed. Currently, there is approximately 37,103 acres of suitable habitat. Red tree voles are believed to have limited dispersal capabilities (USDA and USDI, 1994a) and recent harvest units, early seral stage forests, and roads may be dispersal barriers (Carey, 1989). The extensive fragmentation of suitable habitat may have resulted in small "islands" of habitat with isolated populations of voles with no opportunity of genetic exchange. Therefore, the best suitable habitat for voles is in the mature conifer stands in the large block of mature conifer in the Upknow subwatershed and in the Tilden, Knowles and Barber subwatersheds.

Mollusks and Other Invertebrates

- The NWP listed many invertebrate species as survey and manage species (USDA and USDI, 1994). Generally, very little is known about invertebrate species and any discussion of reference and current habitat conditions would be based on speculation. It is likely that some of the survey and manage species are present within the watershed.

4.6.10 Big-Game/Recreationally Important Species

Roosevelt Elk (*Cervus elaphus*)

- **Reference Conditions:** The quality of habitat for elk in the watershed was most likely dependent on the level and amount of natural disturbances that created forage openings. Therefore, elk habitat quality and elk numbers were most likely variable over time.

- **Current Conditions:** The mosaic of seral stages created through timber harvest and conversion to agriculture has created relatively good habitat for elk, providing thermal and hiding cover in close proximity to one another. Recent harvest units and agricultural fields as well as natural openings provide forage opportunity. Private lands managed primarily for timber harvest or agriculture production provide relatively more forage and hiding cover with less thermal cover than federal lands.

- In the Lower Siuslaw watershed, there are approximately 558 miles of road, which equates to a road density of approximately 3.2 miles of road per square mile (Table 9). By comparison, ODFW elk management target levels are 1.0 miles of road per square mile (ODFW, 1992). To meet the ODFW road density recommendations, approximately 2.2 miles of road would need to be closed across the watershed. It should be noted that a portion of the total road miles consist of the sections of State Highways 36 and 126.

Black Bear (*Ursus americanus*)

- **Reference Conditions:** There is no information available regarding the historic distribution and abundance of black bears. Black bear habitat is similar in structure and patch relationship to that used by deer and elk. The mosaic of vegetative types present historically and their distribution across the landscape likely provided good habitat for bears.

- **Current Conditions:** No population estimates for bears in the Lower Siuslaw watershed are available. Black bear density for western Oregon is estimated to be one bear/1.1 square miles (ODFW, 1993a). Based on that estimate, the watershed could support a maximum of 158 bears (estimate includes developed areas). This estimate does not take into account the current habitat conditions present in the watershed. Forest management activities have reduced the amount of potential black bear denning habitat by removing large trees, stumps, and logs preferred as den sites (Noble et. al., no date).

Cougar (*Felis concolor*)

- **Reference Conditions:** No historic information on distribution and abundance of cougar in the watershed is available. Cougar populations are linked to prey levels and cougar populations most likely fluctuated with the population trends of their prey base.

- **Current Conditions:** No census of cougars has been conducted for the watershed. However, cougar populations are believed to be expanding throughout Oregon. Average density for Oregon has been estimated at 7.5-7.8 cougars per 100 square miles (Johnson and Strickland, 1992; ODFW, 1993b). Based on that estimate, the Lower Siuslaw watershed could support 13 territories. This population estimate does not consider the quantity of habitat or prey density and availability. Actual populations may vary substantially from this estimate.

4.6.11 Botanical Resources

- Several threatened, endangered, and sensitive (TES) plant species are known to occur in the watershed. All TES plant species except loose-flowered bluegrass (*Poa laxiflora*) and tall bugbane (*Cimcifuga elata*) typically occur on non-federal lands or are located in the dunes, deflation plains, and estuarine habitats in the lower watershed (outside the focus of this analysis). Surveys for TES species were performed in the past prior to ground disturbing activities. Loose-flowered bluegrass and tall bugbane are known to occur within the analysis area. The Siuslaw National Forest has developed a management strategy and monitoring plan for the loose flowered bluegrass that provides sufficient protection for the species. This grass was removed from the USFS Region 6 Sensitive Species List. No management sites have been selected in the watershed. The USFS, BLM, and COE developed a conservation strategy for tall bugbane, including protection criteria and designated management areas. There is one management area along the eastern boundary of the watershed.

4.6.12 Survey and Manage Plant Species

Vascular Plants

- No survey and manage plant species have been documented on federal lands within the watershed. However, potential habitat is present for several species within the watershed. Survey and manage species will be protected through implementation of the Survey and Manage guides (USDA and USDI,1994).

Non-Vascular Plants

- Seven plots within the watershed were surveyed for epiphytic macrolichens as part of a forest-wide survey (Geiser, pers. comm) No other complete surveys for other groups of non-vasular plants are known to have been conducted. Species observed within the watershed are listed in Appendix F.

4.6.13 Noxious and Non-Native Vegetation

- The following is a list plants designated by the Oregon Department of Agriculture (ODA) as "noxious" weeds known or believed to occur in the watershed (USDA and BLM, 1997).

Meadow knapweed	*Centaurea pratensis*
Canada thistle	*Cirsium arvensis*
Bull thistle	*Cirsium vulgare*
Field bindweed	*Convulus arvensis*
Scotch broom	*Cytisus scoparius*
St. Johnswort	*Hypericum perforatum*
Japanese knotweed	*Polygonum cuspidatum*
Tansy ragwort	*Senecio jacobaea*
Evergreen blackberry	*Rubus laciniata*
Gorse (Coastal areas)	*Ulex europaeus*

- Species known or believed to occur in the watershed that are not on the ODA list and are of concern because they are exotic and invasive are listed below. These species may present a significant threat to desired biological resources in the watershed as listed noxious plants (USDA and USDI, 1997).

Common burdock	*Arctium minus*
Foxglove	*Digitalis purpurea*
Teasel	*Dipsacus sylvestris*
Burnweed	*Erechtities minima*
Robert's geranium	*Geranium robertianum*
Sweet pea	*Lathyrus latifolia*
Creeping buttercup	*Ranunculus repens*
Himalayan blackberry	*Rubus discolor*

- These plants and other noxious and/or non-natives adapt well to habitat conditions created by human activity. They typically grow well in open areas where they often out-compete native early seral vegetation and inhibit development of later seral stages. Non-native plants limit site diversity and may prevent recently disturbed sites from returning to their pre-disturbance condition.

5.0 SYNTHESIS AND INTERPRETATION

Comparing existing conditions to reference conditions allows an evaluation and interpretation of changes in specified (as per Section 3.0) physical and biological processes and interactions in the watershed. The causal mechanisms attributed to departures from reference or natural conditions are identified, as are the effects on related factors or processes. Interpreting these provides background for assessing natural and human-related disturbances influencing or altering the Lower Siuslaw River watershed, and its ability to function within a natural range of conditions. These natural conditions frame management objectives set by agency directives, such as the Northwest Forest Plan. Implications of conditions and interactions not meeting management objectives provide the basis for recommendations and opportunities. Information in this step is organized by core topics as identified in Section 3.0.

5.1 ISSUE #1 THE CAPABILITY OF THE WATERSHED TO MAINTAIN AND SUPPORT AQUATIC SPECIES AND HABITAT

5.1.1 Differences Between Reference and Current Conditions

- Reduction in natural coho salmon runs can be attributed to past overharvesting in commercial ocean and Siuslaw River fisheries. Commercial harvest data (1889-1956) showed an annual harvest of about 60,000 coho salmon from 1892 to 1914 from the Siuslaw River (BLM, 1996). After 1914, coho salmon harvests decreased to about 10,000 fish annually, never exceeding 50,000 fish up to the 1950s (ODFW, 1995).

- Based on historic coho salmon harvest levels and current peak coho salmon counts in the Lower Siuslaw watershed, aquatic habitat may be producing only about 2 percent of its historic capability. Selected reference values for functioning habitat (adopted from the North Fork Siuslaw Watershed Analysis; Table 30) were compared to conditions quantified by USFS R6 inventories. All stream reaches were found to be far below reference amounts of LWD and few had sufficient deep-pool area (greater than 1 meter). Comparing inventoried habitat components to the NMFS "Pathway Indicators of Stream Habitat for Coastal Oregon" (NMFS, 1996) suggests most streams would rate non-functional (poor) for LWD, substrate, pool frequency and quality, and off-channel habitat indicators. Historic habitat conditions are perceived as having been of a much higher quality.

Table 30. Reference Values of Selected Aquatic Habitat Variables for the Lower Siuslaw Watershed

Habitat Variable	Good (Functioning)	Fair (Partially Functioning)	Poor (Non-Functional)
Large woody debris (pcs/mile)	80	40-79	<40
% pools (0-2% gradient)	>55	40-55	<40
% pools (3-5% gradient)	>40	30-40	<30
% pools (>5% gradient)	>30	20-30	<20
% deep pools	>20	10-20	<10

Note: values derived from the North Fork Siuslaw Watershed Analysis

- Reference (Pre-Euro-American settlement) temperature regimes for streams in the Lower Siuslaw watershed are unknown. However, in 1996 most stream reaches in the Lower Siuslaw watershed had a 7-day average maximum water temperature during salmonid rearing periods above 62° F, which, according to NMFS, is above optimal rearing conditions. Furthermore, all of the monitoring sites recorded water temperatures above 64° F, indicating a non-functional condition (NMFS 1996) for stream shade and rearing of salmonids in the watershed.

- An additional comparison notes that 3 of the 23 subwatersheds in the Lower Siuslaw River area (Berkshire, upper Knowles, and Brush creeks) have high amounts of mature conifer occupying riparian zones. However, logging of mature conifer in riparian zones along many streams in the remaining 20 subwatersheds has converted vegetation either to a younger seral stage, or a deciduous seral stage, thus altering the vegetative influences that play a role in maintaining natural water temperature regimes. Since high stream temperatures have been recorded and riparian vegetation has been altered in much of the watershed, it is inferred that the historic water temperature regime also has been altered.

- Based on relative changes in conditions, or impacts from human disturbances such as roads and logging, the mainstem Siuslaw River, Sweet and Knowles Creeks and their tributaries, and Divide, Hadsall, Meadow, Munsel, and Walker Creeks have conditions substantially below reference or natural conditions. Watersheds with minimal changes in natural conditions are Brush, Petersen, Saunders, Nielson, and Waite Creeks (Table 31).

Table 31. Comparison of Relative Changes on Streams in the Lower Siuslaw River Watershed

Streams	Roads Conditions	Human Disturbance on Unstable Slopes	Channel Integrity	Riparian Seral Stages	Aquatic Habitat Condition	LWD Recruitment Potential	Fish Status	Land Use Practices	Water Temperature	Sediment	Change in Condition (compared to Reference)
Mainstem Siuslaw River	H	H	L	E-M	F	L	D	AG/GR, L, RD/RR, DK/TG	P	?	H
South Inlet	M	H	?	E	F	L	D	?	?	?	M
Demming	M	L	?	E-L	F	L	D	AG/GR, RD/RR	?	?	M
Lawson	M	L	L	E	F	L	D	AG/GR, RD/RR, DK/TG	?	?	M
Karnowsky	M	L	L	E	P	L	D	AG/GR, L, RD/RR, DK/TG	?	?	M
Peterson	L	L	?	E	?	L	?	?	?	?	L
Hoffman	L	L	?	E	P	L	D	AG/GR, L	P	?	H
Mason	L	M	?	E	?	L	?	?	?	?	M
Sweet and tributaries	H	L	L	E	P, F	L	D	AG/GR, L, RD/RR	P	F	H
Marlin	H	L	?	E	?	L	?	?	?	?	M
Hadsall	H	H	L	E	F, P	L	D	L, RD/RR	?	?	H
Knowles and tributaries	H	H	L	E-L	P, F, G	L-H	D	L, RD/RR	P	?	H
Old Man	L	M	L	E	F	L	D	?	?	?	M
Brush	L	L	L	L	G	H	D	?	?	?	L
Barber	L	M	M	E	P, F	L	D	?	?	?	H
Turner	H	L	L	E	F	L	D	L, RD/RR	?	?	M
Waite	L	M	?	E-L	F, G	L	D	L	?	?	M
Rock	L	L	?	E	F	M	D	RD/RR	?	?	M
Meadow	L	H	L	E-L	P	M	D	RD/RR	?	?	L
Smith	L	H	?	E-L	F	M	D	RD/RR	?	?	M
San Antone	H	M	?	E	G	L	D	RD/RR	?	?	M
Beech	L	L	?	E	F	L	D	RD/RR	?	?	M
Pat	L	H	?	E	F	L	D	RD/RR	?	?	M
Tilden	L	L	L	E	F, P	M	D	?	?	?	M
Cleveland	L	M	?	E-L	P	L	D	L	?	?	M
Thompson	H	M	?	M-L	P, G	H	D	L, RD/RR	?	F	M
Shoemaker	L	M	L	E-L	F	L	D	L, RD/RR	?	?	M
Walker	L	M	L	E-L	P	M	D	AG/GR, L, RD/RR	P	P	H
Berkshire	L	H	L	L	F	L	D	L, WD, DK/TG	?	?	M
Hollenbeck	L	H	L	E	F	L	D	?	?	?	H
Saunders	L	L	?	E-L	F	L	D	?	?	?	M
Neilson	L	L	?	E-L	?	L	?	?	?	?	L
Divide	L	L	L	E-L	P, F, G	M	D	L, RD/RR	P	F	H
Hanson	L	L	?	E-L	F	L	D	?	?	?	M
Schoolhouse	L	L	L	E	F	L	D	L	?	?	M
Munsel	L	L	?	E	F	L	D	?	?	?	L

* For column definitions see the following key. Question (?) marks indicate that there is no information to make a qualitative call

Key to Table 31

Roads condition includes problem culverts, unstable road sections, and roads rated as unstable by Berkeley, L=low number of problem sites, M=moderate number of problems, H=high number of problem sites.

1. Roads and clearcuts located on slopes rated unstable or out-of-range by Berkeley Prognosis. H=high, M=moderate, L=low
2. Channel Integrity is a qualitative rating of the degree of in-stream human impacts from stream cleaning, splash dams, bank stability from livestock grazing, tide gates, and parallel roads and dikes with riparian zones, L=low, M=moderate, H=high.
3. Rating of the dominant vegetative seral stage in riparian areas. E=early, M=mid, L=late
4. Functionality, G=good (functioning), F=fair (at risk), P=poor (non-functioning)
5. LWD Recruitment Potential, L=no or little potential, M=some current potential, H=high potential currently
6. Fish status includes current compared to reference spawner and juvenile numbers, D=depressed, S=strong.
7. Major human use impacts that are causal mechanisms in the watershed, AG/GR= agriculture/grazing, L=past logging activities, RD/RR= roads/railroads, WD = water diversion, DK/TG = dikes/tidegates
8. Water quality includes impacts to temperatures and fine sediment, P=poor, F=fair, G=good.
10. Overall relative change in condition from reference, L= no or minimal change, M= below reference, H=substantially below reference.

5.1.2 Interactions of Biological, Physical, and Human Processes on Aquatic Hotspots

- Most hotspots are currently located on private land and have not been inventoried (Map 17). Of the 151 (32.4 miles) identified hotspots, at least 50 have potentially unstable slopes (as identified by the Berkeley prognosis) either adjacent or just upstream, and are at risk of being affected by a landslide. Most (31 or 62 percent) of these at-risk hotspots are found in Knowles (5.4 miles), Sweet (8.1 miles), and Hadsall (1.8 miles) Creeks and their tributaries and South Inlet (1.3 miles), Demming (1.2 miles), and Waite (2.0 miles) creeks. In some smaller tributaries, such as Petersen, Pat, Cleveland, and Walker Creeks, the only identified hotspot is at risk from potential slope failure.

- The 1996 Flood Assessment inventoried landslides that deposited material either in or upstream from aquatic hotspots. The majority of slides depositing directly into Canyon, Deer, and Hadsall creek tributaries, and Hood, Knowles, Sulpher, Turner, and Waite creeks originated from roads or clearcuts, presumably contributing some degree of fine sediment to hotspots. The majority of slides originating from unmanaged stands likely contributed LWD to hotspots in upper Hadsall, Karnowsky, upper Knowles, Lawson, and Tilden creeks.

- Roads impinging on floodplains or constricting channels adjacent to hotspots occur in the upper mainstem Siuslaw River between Barber Creek and the watershed boundary, and along Beaver, Hadsall, Karnowsky, Knowles, Lawson, Thompson, Turner, and Sweet creeks (Map 27). Some of these road sections affect channel migration and off-channel habitat to some degree. In addition, they may isolate floodplains from the main channel, especially during high water events. Roads in these locations may be severely damaged in flood events, causing fine sediment to be deposited directly in hotspot reaches.

- Fourteen culverts barring fish passage to hotspot locations, as identified by ODFW, (Map 16) occur in Florence, Divide, Berkshire, Thompson, Meadow, Tilden, and lower Sweet subwatersheds. In addition, the Roads Condition Assessment evaluated culvert characteristics that would indicate a potential fish passage barrier. Culverts identified in this assessment exhibiting characteristics typical of a culvert barrier (ex. outlet drops > 6', culvert gradients > 8 percent, lengths > 200', plugged inlets) were not located on any stream reaches currently used by anadromous species.

- Hardwood-dominated areas in riparian areas may not naturally regenerate to conifers. These wet sub-environments (typified by salmonberry plant communities) could revert to shrub communities for long periods of time if conifers do not replace short-lived red alder. Large woody debris recruitment could be limited in such situations for a significant period of time. Hotspots along Barber, Beaver, Hadsall, Hood, Knowles, Karnowsky, Lawson, Meadow, Sweet, Sulpher, Turner, and Tilden creeks

have riparian zones dominated by hardwoods. Source LWD recruitment potential, either stream adjacent (within 150' of a stream, including unstable headwall zones) or on unstable slopes not adjacent to a stream, is currently lacking along hotspots(Map 18).

- Stream temperature monitoring data collected in a single year (1996) at nine sites recorded temperatures exceeding 64° F during the late summer months. Such data could be inferred as indicating an altered stream temperature regime. However, without any historical or base line data with which to compare, and considering that a single year of data is insufficient for determining annual ranges of variation, it is unknown if these temperatures indicate a departure from the range of natural variability. The shade model (Map 19) indicates that shade is inadequate at the precise location of five of the nine monitoring sites.

- However, shade upstream of the Hoffman and upper Knowles monitoring sites, where high stream temperatures were recorded, is adequate. Data recorded at two of the monitoring sites on middle and lower Knowles Creek indicate that stream temperatures exceeded 64° F for more than 30 days (non-consecutive), despite adequate shade along most of the mainstem stream and along tributaries on private industrial timberlands that are predominantly stocked with mixed conifer. This could be attributed to several factors. The bedrock dominated channel, thought to have been created by log drives and splash dams, and a lack of deep pool area, may lend to a greater preponderance for solar radiation to heat up the water. Furthermore, a disconnection between the mainstem channel and its floodplain likely has lowered the water table, thereby decreasing summertime base flows, and increasing the capacity for solar radiation to influence water temperature. Consequently, it is thought that shade is not the major contributing factor of high stream temperatures recorded on Knowles Creek.

- In addition, shade is determined to be predominantly adequate in the Hoffman subwatershed. Yet stream temperatures exceeding 64° F for 55 consecutive days were recorded at the monitoring site at the stream mouth. Tidal influences and site location may be more of a factor influencing elevated stream temperatures at this location than riparian vegetation.

- Topographical influences provide shade during certain daylight periods. Therefore, some shade provided by the mountains and ridges in the watershed, likely offset the effects of inadequate shade provided by vegetation along riparian zones in mid and late summer, especially streams with a north-south orientation. In contrast, drainages with more east-west orientations, likely receive the longest duration of exposure to the sun, such as Turner and Walker Creeks, and the mainstem Siuslaw River. Consequently, stream temperatures there may be influenced by solar radiation despite adequate riparian shade.

- Non-forest habitat (grass/forb) along aquatic hotspots in South Inlet, Duncan Slough, and the lower reaches of Lawson, Karnowsky, and Sweet Creeks have the greatest potential for elevated stream temperatures resulting from an increase of solar radiation due to a lack of shade. Non-forest habitat along these reaches has been converted predominantly by agricultural practices from forest or brush dominated riparian vegetation to grass/forb plant communities. Currently, there are no stream temperature monitoring sites along any of these reaches.

- Stream temperature monitoring data does not conclusively indicate, nor refute, that the condition of riparian vegetation is a primary contributing factor to elevated stream temperatures during mid and late summer. It is possible that stream temperatures exceeding 64° F at certain times of the day, or for a certain duration, is within the natural range of variability. Consequently, shade is not perceived to be a limiting factor along forested riparian plant communities, however, it may be limiting along non-forest riparian plant communities.

5.2 ISSUE #2 CONDITIONS OF THE EXISTING ROAD SYSTEM.

5.2.1 Alterations to Reference Watershed Conditions from Roads

- Many roads from which slides have originated, have existing problem sites as identified by the Roads Conditions Assessment (RCA) and the District Road Manager. These roads are located on landforms shaped by infrequent and seasonal, large storm events, implying that roads have affected several ecosystem processes in the watershed. Road segments in the watershed are thought to have increased slide frequency and sediment production and delivery. They are also thought to have limited the routing of LWD through the watershed, to some degree.

- Many road segments exist on unstable slopes, making them prone to landslides. In addition, many unstable road fills occur on slopes that are themselves only moderately stable, increasing the risk of failure on slopes where landslides may have been less frequent historically. Consequently, it appears that the natural regime of slide disturbances in the watershed has been expanded, possibly spatially and temporally. Furthermore, road-related slides are often comprised primarily of fill material, implying that fine sediment contributions to streams likely have been elevated. Roads are also thought to have increased surface erosion potential through the exposure of bare soil by prism components, such as cut banks and road treads, on many routes. However, whether those contributions actually exceed the range of natural variability is unknown. Nonetheless, roads are thought to have altered somewhat the inherent sediment regime across the landscape.

- Many road segments in the watershed closely parallel steam courses, often impinging on floodplains or stream banks. Roads in these locations are very prone to damage from floods and landslide deposits since they occur in lower drainage locations where cumulative flood stages are manifested. Roads occurring in valley bottoms and on floodplain landforms may also obstruct LWD transport to stream channels from

upslope sources (Map 18). Where road segments in valley bottoms cross tributary confluences, fill material and the associated culvert may not allow for passage of LWD to third- and fourth-order streams.

- Transport of at least 20 percent of LWD to hotspots from potential source sites is blocked by arterial roads in Cedar, Hand, Hood, Knowles, San Antonio, and Lower Sweet subwatersheds. State highways 36 and 126, as well as County Road 5020, block LWD sources along the mainstem Siuslaw River and Knowles Creek.

- Most of the roads and road segments that appear to affect the landslide, sediment, and LWD transport regimes are primary arterial travel routes in the watershed (including ATM roads). The secondary roads in the watershed, such as system and non-system spurs, do not appear to affect the watershed as much. Moreover, the RCA identified fewer problem sites on these roads than on primary arterial routes.

- Road density within the watershed may adversely affect late-successional wildlife and big-game species. Twenty of the 23 watersheds have road densities greater than 2 miles per square mile. Road densities greater than this have a substantial impact on habitat utilization by deer and elk (Thomas, 1979; Brown et al., 1985). Roads may assist the invasion of non-native plants, increase access for edge predators, and increase human activity in the LSRs, potentially increasing the likelihood of direct disturbance to late successional species from noise, poaching, vandalism, or human caused wildfire. Roads also may limit movement of some small and/or less mobile species, reducing available habitat and limiting dispersal and migration.

5.2.2 Proficiency of the Current Road System to Meet Current Management Objectives

- A predominance of the main arterial roads in the watershed maintained in perpetuity by the ATM plan, including county roads and state highways, have drainage or stability problems (Map 12). Consequently, it appears that many sections of the main arterial and access roads in the watershed do not meet Aquatic Conservation Strategy objectives, since they directly impact riparian and aquatic resources at many locations, especially in Beaver, Hadsall, Lawson, Karnowsky, Knowles, Sweet, and Turner creeks, as well as the mainstem Siuslaw river.

- Many of these roads are in valley bottoms, directly in riparian zones. They contribute sediment to aquatic habitat from heavy traffic, cut-bank erosion, ditch erosion, and tread erosion. In addition, many of the arterial roads in riparian zones impinge on floodplains and channels, and are constructed of "sidecast" technique. These valley bottom roads also often disrupt natural hydrologic flow paths. Arterial roads on ridgetops, and mid-slope roads connecting valley-bottom travel routes with ridge routes, are of "sidecast" construction and occur on steep, unstable slopes. Slides have originated from these roads, transporting fine sediment downhill to streams. Impacts

of this nature are not considered to meet ACS objectives for protecting aquatic habitat and anadromous fisheries from road related impacts. Aquatic hotspots, specifically those in the aforementioned streams, are being affected by roads.

- Secondary travel routes and spur roads, not identified as primary travel routes, comprise about 40 percent of the entire road system in the watershed. These roads, most of which are ridgetop roads, appear to affect aquatic and riparian habitat the least of all roads in the watershed (Map 30). Nonetheless, there are sections of these roads that impact aquatic habitat, thereby failing to meet ACS objectives. These kinds of roads are thought to be necessary for near-term access (Map 30a) where there are stands ripe for thinning activities. In addition, these secondary roads access younger plantations, thus being necessary in a more distant future to access thinning opportunities.

5.3 ISSUE #3 THE CAPABILITY OF THE LATE-SUCCESSIONAL RESERVE TO FUNCTION AS A LATE SUCCESSIONAL ECOSYSTEM AND SUPPORT RELATED WILDLIFE SPECIES

5.3.1 Differences Between Reference and Current Late-Successional Habitat Characteristics and Distribution

Disturbance Processes

- Timber harvest has replaced fire as the dominant disturbance, resulting in decreased late-successional patch size, increased fragmentation, reductions in biological legacy material (remnant green trees, snags, coarse woody debris, etc) and reductions in remnant late-successional patches within disturbance areas.

- Many areas within the watershed are predominantly in the stem-exclusion phase. The majority of these stands are the result of same-age, single-species plantation management. Unlike stands developing following a natural disturbance, these stands lack tree species diversity and structural heterogeneity created by remnant material, variable regeneration rates, and natural thinning from wind, fire, disease, or other environmental stress.

- Logging on unstable slopes likely has increased landslide frequency there to some degree. As a result, a greater percentage of the unstable slopes in the watershed may be in a pioneer, deciduous seral phase than historically occurred. These areas are likely to remain in this condition for a significant period of time.

- Patch sizes have decreased significantly compared to patch sizes in natural conditions. Average late successional conifer patch size has decreased from very large (greater than 1,000 acres) to 102 acres, with a corresponding increase in the number of patches.

- Roads and harvest units have fragmented the watershed, resulting in a change from large, connected patches having high within patch vegetation species and structural heterogeneity, to numerous small, isolated patches with low species and structural heterogeneity.

- The amount and distribution of biological legacy material (remnant green trees, snags, coarse woody debris, etc.) typically present following disturbance has been reduced by timber management activities.

- Historic disturbance processes left individual or groups of trees, snags, and or down logs relatively unaffected. These remnant structures provide habitat for late-successional species within the regenerating stand significantly sooner than if all or most of the structure was removed. Generally, timber harvest removed the majority of trees and dead wood from a site, leaving little remnant material.

Interior Habitat

- Harvest distribution and rotation timing, road building, and conversion of forest lands to agriculture and development have substantially reduced the amount of interior habitat within the watershed. All remaining interior habitat is on federal land and widely spread across the watershed.

Late-Successional Dependent Species (includes Threatened and Endangered)

- Late-successional dependent species (including threatened and endangered species) habitat has generally declined over time as a result of human-related habitat loss. Most remaining late-successional habitat is on federal land.

- Anthropogenic effects (timber harvest, conversion to agriculture, etc.) have caused fragmentation and reduction in late-successional patch size reducing the amount and quality of habitat available for late-successional dependent species, including spotted owls and marbled murrelets. This human activity (sometimes combined with extensive eradication efforts) has resulted in local and/or regional extirpation of several species (gray wolf, wolverine, fisher), and federal listing (threatened) of several others (northern spotted owl, marbled murrelet, bald eagle). The grizzly bear, however, which formerly occupied the Coast Range, was last seen there in 1820, before substantial human alteration of the landscape (USDA and BLM, 1997). These human activities began at the turn of the century and continue today on private lands. They have been substantially curtailed on federal lands within the watershed through implementation of the Northwest Forest Plan and designation of the majority of the area as an LSR.

Riparian Areas

- Timber harvest, roads, and agriculture have fragmented riparian areas and historic vegetation communities along the substantial majority of streams in the watershed (only Brush Creek appears intact) (Map 24). Timber harvest frequently has resulted in conversion of riparian areas from conifer-dominated to deciduous-dominated.

- Historically, major disturbances processes had substantial influence on structure and vegetation of riparian areas. In all cases, legacy material and functioning refugia remained to support the recovery process. Timber harvest, splash dams/log drives, and/or stream clearing have resulted in increased spatial and temporal changes in riparian habitat structure and vegetation.

Big Game

- The spatial and temporal distribution of habitat types and seral stages created by timber harvest likely have increased the amount of suitable habitat for big game in the watershed.

5.3.2 Interactions of Biological, Physical, and Human Processes on Late-Successional Habitat Characteristics and Distribution

Disturbance Processes

- Current vegetation patterns in the watershed are not within the range of natural variability. Historically, natural disturbances resulted in vegetation patterns and physical structures that varied widely, both spatially and temporally. Although it is possible that, during some periods, historic conditions had similar quantities of vegetation in each seral stage present today, it is unlikely that current spatial distribution of vegetation patterns and within-patch structure (number of canopy layers, logs, snags, tree size) is similar to spatial distribution before management.

- Even-aged management has resulted in a relatively high proportion of stands in the stem exclusion phase, which has closed canopies and is structurally homogeneous. These areas provide little habitat for species, such as spotted owls and marbled murrelets, requiring certain structural attributes for nesting and foraging habitat. Left untreated, many of these overstocked stands could remain in the stem-exclusion stage for many decades, extending the time needed to develop late-successional characteristics.

- Human-induced increase in landslides (from roads and logging) has caused an increase in deciduous pioneer stands of alder that would not be expected to attain late-successional characteristics in the near future. It is unlikely that these areas will establish late-successional stands without significant intervention. On some slide sites, no amount of remediation would result in late-successional characteristics in the foreseeable future.

- As a result of decreases in average patch size, late-successional dependent species with large home ranges in the watershed must cross unsuitable areas and travel further to meet their life requirements. This exposes them and their young to increased predation risk and causes increased energy expenditure. Late-successional species with low mobility and small home ranges (amphibians, small rodents, insects, and others) become isolated and susceptible to stochastic and human caused disturbance events. Extirpation of these isolated populations reduces the sources available for recolonization of disturbed adjacent areas as they develop habitat conditions suitable for these species.

- Fragmentation has reduced the ability of some species to disperse successfully or migrate to new habitats. The small patch size and isolation of individual late-successional patches is particularly evident in the mosaic of private and state lands in the eastern portion of the watershed, but also is evident, although to a lesser extent, on federal lands in the central portion of the watershed (Hand, Cedar2, Lower Sweet, Hadsal, and Berkshire subwatersheds). Even the large blocks of late-successional forest in the Bailey Ridge, Bald Mountain, and southern portion of the Upper Knowles subwatershed have become isolated from adjacent late-successional patches. These large areas may be sufficient in size to maintain viable populations of some late-successional species, with sufficient reproduction and survival to provide excess populations that could colonize adjacent habitats. However, dispersing juveniles would have to cross large, unsuitable areas, potentially reducing dispersal success.

- Removal of the majority of large green trees, snags, and down logs by human disturbance, such as timber harvest, will affect the ability of areas to provide or develop late-successional characteristics. Following natural disturbances this legacy material provides temporary refugia for late successional species, results in more rapid attainment of late -successional characteristics, and provides transient habitat and/or protective cover for late-successional species to use as they move between patches of suitable habitat (Franklin et. al., 1997).

- Logging and other land management activities have reduced the number of very old, structurally diverse stands. These areas are likely very rare in the watershed and limited to steep northeast slopes and riparian areas. Although sufficient information was not available to determine the location of biological hotspots in the watershed, the potential location of these areas is shown on Map 25. Where these areas exist, they may have special importance for this watershed as refugia for late-successional species, until habitat conditions within the LSRs become suitable for recolonization.

- The majority of federal lands within the watershed is designated as LSR. The resulting cessation of programmed harvest activity in most of these areas will, over time, either naturally or with restoration efforts, increase late-successional patch size and increase connectivity in the watershed.

- Most of the Matrix lands are isolated, and management of these areas for timber production or other allowable uses should have little effect on the function of the LSRs. Riparian Reserves dissect most of the Matrix lands. Current harvest practices on federal land have been designed to provide enough legacy material, so that harvest units should continue to allow movement of late-successional species across the landscape. Harvest in these areas primarily will provide habitat for early- to mid-seral associated species.

- Habitat on federal lands within the watershed is generally in recovery. However, some areas dominated by deciduous species and salmonberry may take many years, even with restoration efforts, to revert to pre-disturbance conditions. As these areas recover, they will begin to complement the existing older stands and provide travel corridors for many mobile and less mobile species existing, or potentially existing, in the watershed.

- Timber management within Matrix land in the Walker, Berkshire, and Thompson subwatersheds will add diversity in the LSR by providing young and mid-seral forest habitats adjacent to LSR, without compromising connectivity. Management of the remaining Matrix land should have little effect on LSR function.

- The area affected by recreation and matrix lands is small relative to LSR in the watershed. The likelihood of adverse effects from these activities is expected to be negligible.

- Recreational opportunities other than hunting are limited to water bodies (primarily the Siuslaw River), roads, and a few trails. These activities typically result in isolated, small areas of disturbance, and generally have minimal impacts on wildlife species.

Interior Habitat

- Interior-habitat-dependent species numbers are expected to correlate directly with the amount of interior habitat available. Reduction in average patch size, and the corresponding increase in fragmentation, limit the amount of interior habitat available. The limitation of available interior habitat results in altered vegetation communities and potential increases in predation, reduced reproductive success, and increased energy expenditure related to thermoregulation, caused by decreased mitigation of weather extremes.

- Some interior-dependent species, such as soil bacteria, fungi, and the species responsible for dispersing them (rodents) are integral to re-establishing functional late-successional habitat. The limited amount of interior habitat and the large distances between patches cause disturbance events affecting even small amounts of interior habitat potentially to have significant effects on long-term restoration of late-successional habitat

Late-Successional Dependent Species (includes Threatened and Endangered)

- Due to the current landscape pattern and human population, it is unlikely that any of the extirpated species will establish viable populations in the watershed without direct, extensive human intervention.

- The home-range circle of each known owl activity center in the watershed overlaps at least one other, possibly due to current forest alteration. Competition for the same resources may reduce the amount of habitat for some owl pairs, thus increasing energy expenditure for territorial defense. However, it is not known how individual pairs use available habitat, nor is the historic distribution of owls known. Therefore, this overlapping may be a natural occurrence for this watershed.

- Despite the level of fragmentation, owls and murrelets occur throughout the watershed, and are concentrated on federal lands. Home ranges that overlap private land have less suitable habitat than those entirely on federal lands. These owls may be at risk of reduced reproductive success and survival due to the combined effects of lower quality (or lack of sufficient) habitat within their home range and competition from other owls. Fragmentation and decreased interior habitat may increase murrelet nest predation by corvids and other edge species, by reducing the distance from edge to nest, thus making it easier for predators to find the nest in the stand.

- Human activity has decreased bald eagle habitat and the amount of potential forage within the watershed. The highest-quality remaining habitat is located along the Siuslaw River. However, this habitat is compromised by the proximity of roads, private development, and river traffic, and the lack of large trees suitable for nesting. Map 28 shows the location of the best potential bald eagle habitat within the watershed.

- Habitat within designated bald eagle management areas on Forest Service land is fragmented, and human disturbance may limit the use of some portions of all three management areas. However, present suitable nesting habitat and forage areas probably are sufficient to support the two existing bald eagle nest.

- Reductions in the number of large green trees and snags has decreased habitat for late-successional associated bat species. Certain types of bridges provide night roosting habitat for some species of bats, partially replacing the loss of large, old trees and snags.

- Management for LSR objectives and Riparian Reserves will increase suitable habitat for threatened and endangered species on federal lands. It is highly unlikely that most of the threatened and endangered species now extirpated in the watershed will recolonize the watershed even after suitable habitat increases.

- Management for LSR objectives will reduce big-game habitat within the LSR and concentrate those species on LSR/matrix and LSR/private land boundaries, resulting in less hunting traffic within the LSR and less likelihood of disturbance to late-successional species.

- The east-central portion of the watershed is dominated by privately-held commercial forest lands. It is assumed that harvest rotation will be 40 to 80 years. Management of these lands must meet Oregon State Forest Practices Act rules. Incorporation of these rules will provide maintenance and creation of some late-successional stand attributes within young seral-aged stands dominating private lands within the watershed. Private timberland, however, will likely continue to provide little structural diversity in the form of large green trees, late-successional interior habitat, snags, and downed logs. It will, however, continue to provide habitat for early and mid-seral species, and important habitat juxtaposition for species such as elk and deer.

Riparian Areas

- Deciduous-dominated portions of riparian areas may not regenerate naturally to conifers. Wet sub-environments (typified by salmonberry plant communities) could revert to shrub communities for long periods of time if conifers do not replace short-lived red alder.

- Unlike historic disturbances, human related disturbance is distributed throughout the watershed. Legacy material (large green trees, snags, logs) that would have remained in the system following most natural disturbances has been removed. The even distribution of disturbance across the landscape affected most stream systems during the same, relatively short, time period. Consequently, potential source populations of riparian-dependent species for recolonization that would have existed under historic disturbance regimes may frequently have been removed by human activity. The loss of, or significant reduction in, legacy material may alter biotic processes and affect recovery rates.

- Stand structural change and fragmentation have reduced the ability of riparian areas to provide the microclimate and other habitat conditions necessary for riparian-dependent species, and seriously hinders these species' ability to migrate or disperse throughout the watershed (Map 24). It also limits the Riparian Reserves ability to act as a conduit for movement and dispersal of other late-successional species, as intended in the NWP.

- Conversion of riparian areas to deciduous species or herbaceous species has created wider barriers to movement and removed physical structure (large logs, debris jams) that formerly allowed less mobile species to cross larger rivers and streams, adversely affecting these species' dispersal and movement capabilities.

- Timber harvest and agriculture have resulted in generally uniform disturbance from the edge of water bodies upslope, while valley-bottom roads have created a relatively narrow disruption of habitat continuity between riparian areas and upslope.

- Some species (primarily amphibians, some small mammals and birds) are dependent on the habitat conditions created in riparian areas. Fragmentation of these areas reduces habitat and these species' dispersal/migration success.

- Fragmentation of the riparian vegetation community is highest on private lands and along the larger streams in the watershed (Knowles and Sweet creek). Species dependent on late-successional riparian forest conditions will be rare in these areas, if present at all.

Big Game

- Management for LSR objectives and Riparian Reserves will, over time, alter the amount and distribution of big-game habitat. As federal lands transition to late-seral conditions, big-game forage habitat will be reduced, while thermal and hiding habitat will increase. Foraging likely will be concentrated on private timber lands and federal land designated as Matrix, if these lands are maintained in seral stages conducive to elk and deer foraging (e.g., young age class). Winter use will increase on federal lands as they transition to late-seral stages, providing thermal and hiding cover. Generally, the anticipated long-term changes in big-game habitat likely will cause a seasonal shift in the use of the watershed by deer and elk, and may result in an overall reduction in the number of these species within the watershed. The resulting pattern of use and population numbers may be similar to pre-European settlement, when these species typically were concentrated at the interfaces of disturbed areas and late-successional habitat, to take advantage of the readily-available forage in close proximity to cover.

6.0 RECOMMENDATIONS

The following recommendations are based on the assessment of ecological functions and conditions of the watershed from GIS-based data, review of the LSR Assessment and other relevant literature, consultation with knowledgeable professionals, and professional judgment. Recommendations were developed with the goal of moving toward the objectives of the Northwest Forest Plan and Aquatic Conservation Strategy. Most of the recommendations are presented on a general scale. The recommendations refer to conditions common throughout the watershed and will require site-specific analysis prior to implementation to achieve the goals effectively. The recommendations presented are intended to occur on federal land, although most would also apply to private land, particularly with regard to aquatic habitat. In some subwatersheds, the overall success of the proposed restoration will be dependent on extent, location, and cooperation of private land owners, as well as the location of major public transportation routes (Highways 36, 126, 101).

6.1 AQUATIC SPECIES AND HABITAT

6.1.1 Subwatersheds

- To improve watershed, riparian, and aquatic habitat conditions in subwatersheds with substantial amounts of important habitat on private land, institute Watershed Coalitions/Councils/Groups involving a collaborative group of all land owners in the watershed (Siuslaw Watershed Council), including federal, state and private parties or organizations. This includes a restoration program that will show positive gains in habitat conditions to meet goals established in ODFW's Siuslaw River Fish Management Plan, and the Oregon Conservation Plan.

- To determine near-natural temperature regimes for the Lower Siuslaw River watershed, establish a temperature monitoring station at the mouth of Brush Creek. In addition, continue to monitor water temperatures at the stations mentioned in Table 16.

- In the Lower Siuslaw River watershed, subwatersheds that are generally most impacted by human activities also have the highest capability to produce anadromous salmonids. Relative priorities for restoring subwatersheds are (Map 29):

High Priority	Medium Priority	Low Priority
Cedar2	Siboco	Cox Island
Lower Sweet	Lawson	Florence
Upper Divide	Divide	Hand
Walker	Hoffman	Tilden
Hadsall	Berkshire	Waite
Knowles	Thompson	Meadow
Hood	Barber	
Upper Knowles	Turner	
	San Antone	

6.1.2 Fish Species

- Complete a fish-presence inventory to determine more accurately the extent of anadromous fish-bearing streams.

- Complete an inventory of all culverts on anadromous fish-bearing streams to determine potential barriers to upstream and downstream migration of adult and juvenile fish (Map 29).

6.1.3 Aquatic Habitat

- Replace or alter culverts on Road 5034 on Perterson Creek, Road 5260 on Munsel Creek, and Road 5020 on Tilden Creek to improve upstream and downstream fish passage for anadromous fish.

- Access culverts on non-essential roads that potentially block LWD transport. Also, remove culverts and close roads Priority subwatersheds are:

  - Lower Sweet
  - Cedar
  - Knowles
  - Hood

- Protect all stream reaches determined to be intact or in functioning condition (those reaches with mature conifer riparian areas, channels with LWD, and pool and off-channel habitat within natural cumulative relative frequency distributions). More specifically:

  - Upper Knowles Creek on BLM land
  - Middle and upper Meadow Creek
  - Upper Thompson Creek
  - Middle Divide Creek
  - Upper Waite Creek
  - Brush Creek

- Use existing and newly-developed USFS R6 and ODFW stream inventory information for the entire Siuslaw River Basin to establish cumulative relative frequency distributions and spatial displays by reach group for selected habitat variables that best determine reference habitat conditions for the Lower Siuslaw River watershed (Overton, et. al., 1995).

- Complete modified USFS R6 or ODFW stream inventories on all private and federal streams containing salmonids. Highest priority stream reaches would be all hotspots, especially those located on private land, such as:

  - Brush Creek
  - South Inlet Creek
  - Demming Creek
  - Lawson Creek
  - Lower Divide Creek
  - Schoolhouse Creek
  - San Antone Creek
  - Meadow Creek
  - Rock Creek
  - Cleveland Creek
  - Sweet Creek
  - Hadsall Creek
  - Hoffman Creek
  - Tilden Creek
  - Pat Creek
  - Turner Creek
  - Barber Creek

- Restore/stabilize unstable areas adjacent to hotspots, including (Map 29):

  - Mainstem Siuslaw River
  - Lower Thompson Creek
  - Upper Barber Creek
  - Lower San Antone
  - Middle Pat Creek
  - Lower and middle Knowles Creek

- Restore, in the short term, aquatic habitat conditions by installing instream structural components in all hotspots determined to have degraded conditions (Map 29). This includes prioritizing hotspots at the project level for restoration with those on the major drainages (i.e. Knowles, Sweet, Lawson, and Divide Creeks) receiving the highest priority. Highest Priority (hotspots in stream reaches with anadromous fish and functioning at risk) are:

  - Middle Waite Creek
  - Middle Barber Creek
  - Middle and upper Divide Creek
  - Upper Hanson Creek
  - Demming Creek
  - Schoolhouse Creek

- San Antone Creek
- Lower and middle Sweet Creek to falls
- Upper Lawson Creek
- Middle and upper Knowles Creek
- Upper Hadsall Creek

- Lower Priority (hotspots in stream reaches with anadromous fish and non-functional) include:

  - Hoffman Creek
  - Lower and middle Hadsall Creek

- Lowest Priority (hotspots in stream reaches with only resident cutthroat trout) are:

  - Upper Sweet Creek above the falls

- Conduct thinning of deciduous/hardwood and/or early seral-stage conifers, and underplanting of conifers in early seral-stage riparian zones to promote increased and faster regeneration of conifers (Map 29). Riparian zones in source and transport channels entering perpendicularly and in a straight line to depositional areas, adjacent to and upstream from hotspots, should receive the highest priority for treatment. More specifically:

  - Lower Knowles Creek (Knowles Creek subwatershed)
  - Karnowsky Creek
  - Hoffman Creek
  - Upper Thompson Creek
  - Lawson Creek
  - Sweet Creek (Lower Sweet and Cedar2 subwatersheds)
  - Hadsall Creek
  - San Antone Creek
  - Rock Creek
  - Turner Creek
  - Demming Creek
  - Waite Creek
  - Pat Creek
  - Barber Creek
  - Peterson Creek
  - South Inlet Creek

- Remove/modify all tide gates restricting tidal flows into tributaries used by anadromous fish.

- Stabilize, upgrade, storm proof, or decommission all unnecessary roads adversely influencing riparian zones and stream habitat.

- If needed, redesignate riparian zone management areas to incorporate new information for fish-bearing streams.

- Protect and restore (by using riparian strip fencing) riparian areas of land affected by grazing on Karnowsky Creek. This includes evaluation of the 45-acre, special use grazing permit on Karnowsky Creek (Map 29).

- Acquire private land on lower Karnowsky, Hoffman, and Lawson Creeks (Map 29).

- Acquire lands between Duncan Inlet and the mainstem Siuslaw River to restore habitat back to the original intertidal and subtidal estuary (by breaching levees; Map 29).

- Continue adding salmon carcasses to key salmonid production areas to enhance stream nutrients.

- Restore natural vegetation in riparian areas now dominated by grass/forbs. These areas are probably the only stream reaches that have shade below natural levels in the Lower Siuslaw River watershed. More specifically, these areas include:

  - South Inlet Creek
  - Demming Creek
  - Lawson Creek
  - Sweet Creek
  - Knowles Creek
  - Mainstem Siuslaw River

- Identify key stream reaches where conifers are lacking. Plant shade-tolerant conifers at low densities, to provide protection from shrub competition and animal damage.

- Identify areas in key stream reaches where conifers are already large enough to provide LWD. Consider active management of the area to furnish structural wood to the stream.

- Manage plantations (and overstocked natural stands) in mid-seral conditions to produce LWD by thinning to accelerate growth. This is a short-term strategy that can be concentrated in most important stream reaches.

- Pre-commercially thin young plantations to increase long-term growth, develop stand sizes and conditions that produce LWD, and provide shade. Again, activities should be concentrated in the most important stream reaches (long-term strategy).

- Within Riparian Reserves, manage the area outside the stream-influence zone to achieve LSR objectives.

6.2 ROADS

Refer to Map 30 for recommendations listed here related to the management of roads in the watershed.

- Given that many of the poor road conditions identified in the watershed occur on primary travel routes, it is recommended that they be given the highest priority for treatment. These arterial roads are likely the long-term infrastructure and travel routes that will remain open in the watershed. Furthermore, many of these road segments do not meet ACS objectives. Many of these routes are also on Forest Service land where the feasibility of repairing degraded road conditions is assumed to be easier to facilitate, leading to a high potential for success. In addition, some problems are located on roads with designated Road Use Agreements between the Forest Service, BPA, and a private industrial timberland owner. These roads also would have high priority for restoration, since the agreement between land owners is to maintain shared access. Currently, the sections of these arterial routes where poor road conditions occur do not meet ACS objectives.

- Generally, the objective on these roads would be to upgrade them according to ACS objectives.pertaining to the maintenance of the physical integrity of the aquatic system, riparian areas, and water quality. Specifically, repair and upgrade the arterial routes along Beaver, Hadsall, Karnowsky, Lawson, San Antone, Sweet, and Thompson creeks that currently inhibit LWD transport, produce and deliver sediment to the streams, alter the hydrologic regime, and impinge on floodplains and wetlands. Primary treatments on these roads should focus on repairing or improving unstable road segments and problem culvert sites identified by the RCA and the District Road Manager. The simplest and most beneficial quick fix project would be to clean out all plugged and partially-plugged culverts.

- Upgrades or repairs on these roads also would be beneficial and might include such practices as installing larger diameter culverts at specified stream crossing locations, or stabilizing a sinking road prism. Secondary treatments on these roads may also be beneficial in the long term, such as minimizing road-related sediment production by implementing erosion control practices. One example might be an application designed to minimize cut-bank ravel. Specific road treatments should be designed at the project level to account for site-specific conditions and circumstances.

- There are other arterial roads in the watershed not on the current ATM plan, such as County Road 5020, that should be considered for inclusion into a watershed-wide plan. These roads are primary travel routes providing access across watershed and ownership boundaries. Since these roads are generally considered primary arterial routes in the watershed, they should be recognized as roads that are likely to remain in the watershed for many years. The conditions of many of these roads have not been assessed.

- Roads in the eastern portion of the watershed have not been evaluated. The most recent assessment was unable to access many roads that occur in Barber, Meadow, San Antonio, and Tilden, subwatersheds. Many of these roads access private industrial forest land, BLM land, and Oregon Department of Forestry land. The condition of many of these road segments is unknown. Furthermore, the Berkeley model suggests numerous road segments in the San Antonio and Tilden subwatersheds that occur on slopes rated as unstable or moderately stable. Therefore, a condition assessment may be helpful in identifying problems needing attention on roads crossing multiple ownerships.

- The next priority would be to consider temporarily closing spur roads, or local roads with low maintenance designations, that access plantations ten years old or younger (Map 30a). Coordinate with the BLM, ODF, ODFW, and private land owners to develop a road closure plan for subwatersheds with road densities greater than 2 miles per square mile. Roads accessing these sites generally are not needed for near term forest management activities and are perceived to be somewhat useless, in terms of access, for 10 to 20 years. Consequently, these roads, particularly those with problem segments such as unstable fill slopes, present a near-term road closure opportunity. These roads could be treated with some form of storm proofing, such as waterbarring or stream crossing removal, to minimize potential drainage or failure problems that could arise from a lack of maintenance. Many of these roads could be closed easily, at a relatively low cost, after pre-commercial thinning or brush release activities. For example, a road with dense vegetation growing along both sides simply could be scarified and waterbarred as site preparation for adjacent seed sources, especially alder. Waterbar installation should strive to avoid diverting concentrated flow to fill slopes.

- Certain maintenance level-one roads in the 2610 and 2680 road systems have not been waterbarred (Appendix B). Installing waterbars on maintenance level-one roads is part of an ongoing Forest Service effort to provide some surface drainage features on roads that will not be maintained regularly. This would minimize road damage that could result from neglect. This type of effort is also relatively inexpensive and easy to implement.

- There are some roads that could be removed from the road system entirely. These roads do not appear to be necessary for any forest management activities; they are maintenance-level spur roads that do not provide access to any identified unique locations such as dispersed campsites. A form of road obliteration could be considered appropriate for decommissioning these roads. Priority should be given to those roads with identified problem sites.

- Roads in areas with high concentrations of overstocked, mid-seral stands (commercial-sized stands in the stem-exclusion stage) and predominantly federal ownership are high priority for retention for near-term forest management activities, such as thinning to promote late-successional habitat. These roads represent future restoration opportunities. Their future, in terms of remaining open or closed, should

be decided upon during forest management project planning by District Interdisciplinary teams. In the meantime, however, any road problem sites identified by the RCA should be given priority status, since these roads could remain open for a number of years. Restoration activities should repair or upgrade any problem sites as needed.

6.3 THE CAPABILITY OF THE LATE-SUCCESSIONAL RESERVE TO FUNCTION AS A LATE-SUCCESSIONAL ECOSYSTEM AND SUPPORT RELATED WILDLIFE SPECIES

6.3.1 Scoping Strategy

A scoping strategy is suggested to provide focus on the highest-priority stands for treatment in the near term. This would involve a sequential series of steps:

1. Identify subwatersheds with predominant federal ownership. As shown in Table 20, these include: Cedar, Divide, Hand, Hoffman, Lawson, Lower Sweet, Thompson, Upper Divide, Upper Knowles, and Walker Subwatersheds.

2. Within these subwatersheds, identify those that have the greatest amount of stem-exlusion stage. These include: Cedar2, Divide, Hand, Thompson, and Walker. (Note that this is a reduction from the previous set of subwatersheds in step 1.)

3. From this subset, identify the subwatersheds that have the greatest near-term potential for accelerating development of late-successional characteristics. This generally coincides with amount of "Mature 50-80," "Young Conifer," and "Young Conifer Mix" stands. It also provides a general indication of commercial opportunities -- those that do not require appropriated funding to accomplish. The subwatersheds include: Cedar2, Divide, Hand, Thompson, and Walker (same as previous set of subwatersheds).

4. Describe specific areas where specific ecological needs have been identified, such as providing connectivity, increasing block size, etc. Examples include:

(a) Lower Sweet: There are opportunities for consolidation and expansion of late successional blocks.
(b) Cedar2 (Western 1/2) and Hand (Southern 1/2): Treatment within selected young stands could accelerate development of late-successional characteristics and create a very large block of contiguous late-successional habitat.
(c) Upper Divide: The Interior Mature Habitat Map (Map 23) shows the location of stands that could be treated to accelerate development of later successional characteristics and substantially increase the amount of interior habitat in several decades.

(d) Other Opportunities: Local resource professionals should identify additional habitat enhancement priorities, based on information provided in this analysis as well as local experience and expertise. Map 31 shows subwatersheds identified as restoration opportunities using these guides.

The remaining steps in the scoping process have not undertaken as a part of this analysis; they are best accomplished by local resource professionals.

5. Consider adjacent watersheds in assessing priorities.

6. Identify most likely stand treatment opportunities on aerial photographs.

7. Conduct detailed, site-specific stand examinations in these areas to determine actual conditions and expected responses, and to develop objectives-based prescriptions.

8. Consider the dynamics of stand development: Assign a high priority to treatment of stands that are likely to grow out of the "window of opportunity" for density management in the near future.

9. Consider short term cost vs. long term benefit of habitat manipulation within a 1.5 mile radius of northern spotted owl activity centers.

6.3.2 Treatments: General

- Emphasis should be given to silvicultural treatments that accelerate development of late-successional characteristics on managed stands. Natural stands should be assessed to determine potential impacts on legacy material (including soil and fungi) prior to implementation of any silvicultural treatment. Treatments requiring activities that would damage or reduce the amount of legacy material within the stand, such as ground skidding that would breakup old large down logs, or cable yarding that would require the removal of snags for safety, should be avoided.

6.3.3 Treatments: Managed Stands

- Many stands in the 50-to-80 year-old class ("Mature 50-80") are excessively dense. Because of high site capability, trees in these stands tend to be very tall relative to their diameter. Tree crowns are often reduced, even on dominant trees, and rooting area is also limited. These stands are often beyond the "window of opportunity" for density management. Attempts at commercial thinning may result in increased windthrow, breakage, and loss of stand growth. Site-specific evaluations are needed to determine individual stand characteristics and capabilities for management.

- "Young Conifer" and "Young Conifer Mix" stands represent an opportunity for commercial entry that can accelerate the development of late-seral characteristics. Stands with larger average diameters and higher volumes will be more viable

commercially, provided access and harvest methods are similar. Also, these stands often reach the upper limits of the "window of opportunity" for stocking control. Again, site specific evaluations are needed.

- Pole-sized stands represent management opportunities that require both time and money investment. Highest-priority stands for treatment are those contributing the most to development of large blocks of land with LSR characteristics. Individual stands should be evaluated for expected growth response, as well as location in the landscape.

6.3.4 Habitat Emphasis Considerations

- Priority should be given to increasing the amount of mature interior conifer habitat. Where interior habitat exists, increase the amount of interior habitat and decrease the influence of edge through silvicultural treatments, particularly within the home range of known spotted owls and marbled murrelets. Stands selected for treatment should increase the circular, square, or rectangular shape of the existing interior habitat. Stand-level prescriptions should be designed to accelerate development of desired characteristics. Consider wide spacing to increase diameter growth and large limb development. Retain some "wolf" trees (exceptionally-fast growing trees that are rough-limbed and occupy a disproportionately large area). Where feasible, use irregular spacing patterns, release shade-tolerant conifers from shrub competition, and establish a second canopy layer of shade-tolerant conifers beneath widely-spaced overstories. The assessment for the Oregon Coast Province - Southern Portion provides an excellent focus on appropriate activities within LSRs (USDA, 1997).

- Use silvicultural treatments to accelerate development of late-successional characteristics within owl activity centers that are currently below 40 percent suitable nesting habitat, or those with home ranges encompassing more than 30 percent private land. Maintain canopy cover of no less than 40 percent in 50 percent of the young conifer/young conifer mix (10 to 18 inches dbh >70 percent cover) through time to maintain foraging and dispersal habitat.

- Provide connectivity between mature forest on federal lands in the Upper Divide, Walker, and northern portion of the Thompson subwatersheds by maintaining or developing interconnected blocks of late-successional habitat through silvicultural treatment and/or harvest unit lay-out. Riparian Reserves should form the core of the connectivity corridor. The location of the blocks of late-successional habitat could be somewhat plastic as long as inter-connectivity is maintained through time. In other words, half of a connectivity block of late-successional forest could be harvested on Matrix land, as long as the other half had achieved or remained in late-successional seral stages.

- Consider potential land exchanges to consolidate the two large contiguous blocks of mature habitat on Bailey Ridge (Knowles, Tilden, and Barber subwatersheds) and Bald Mountain (Thompson and Walker subwatersheds). Consider potential land

exchange to obtain the private land along Sweet Creek to allow restoration of the riparian area and connectivity between the east and west portions of Lower Sweet and Cedar2 subwatershed, and the north and south portions of the Hand subwatershed.

- When prescribing site-specific silvicultural treatments, leave some areas untreated to mimic small-scale natural disturbance and recovery patterns. To provide adequate cover for dispersing or migrating late-successional species, these untreated stands should be maintained at approximately 2 optimal tree lengths (400 to 500 feet apart across the treated area) from the edge of any adjacent late-successional habitat.

- Coordinate with BLM and ODF to manage the small isolated stands of mature forest within the eastern portion of the watershed to provide protective cover for dispersing late-successional species.

- Follow "Survey and Management" strategies in the Northwest Forest Plan.

6.4 LANDSCAPE SCALE PRIORITIZATION OF RECOMMENDATIONS

- In order to prioritize recommendations by subwatershed, restoration priorities for aquatic habitat and late-successional terrestrial habitat were considered in conjunction with conditions that could limit restoration opportunities. The combination of these factors resulted in prioritization of subwatersheds in which restoration activities for individual resources were most likely to be successful and would be synergistic with other resources (Map 32).

- The following analysis was used to prioritize subwatersheds for management activities. The potential for the subwatershed to provide aquatic resources and late-successional terrestrial habitat, and respond to restoration techniques, was given a rating of high, moderate, or low. A score of high, moderate, or low was then given for likelihood of success at the subwatershed scale, based on certain limitations (primarily amount of private land). Each rating of high was given a value of 3, moderate a value of 2, and low a value of 1. The value for each subwatershed was then added to determine overall priority:

  Total value of 8 to 9 was given high overall priority
  Total value of 5 to 7 was given medium overall priority
  Total value of 3 to 4 was given low overall priority

Table 32. Overall Prioritization of Management Recommendations by Subwatershed

Subwatershed	Aquatic Priority	Terrestrial Priority	Limitations	Score/Priority
Barber	2	2	2	6/M
Berkshire	2	1	2	5/M
Cedar 2	3	2	3	8/H
Cox Island	1	1	1	3/L
Divide	2	2	2	6/M
Florence	1	1	1	3/L
Hadsal	3	1	1	5/M
Hand	1	2	3	6/M
Hoff	2	2	3	7/M
Hood	3	1	1	5/M
Knowles	3	2	2	7/M
Lawson	2	2	3	7/M
Meadow	1	2	2	5/M
San Antone	2	1	1	4/M
Sibco	2	2	1	5/M
Lower Sweet Creek	3	2	2	7/M
Thompson	2	3	3	8/H
Tilden	1	3	2	6/M
Turner	2	1	1	4/L
Upper Divide	3	2	3	8/H
Upper Knowles	3	3	2	8/H
Waite	1	2	2	5/M
Walker	3	3	3	9/H

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